

SMITHSONIAN
MISCELLANEOUS COLLECTIONS

VOL. 84



"EVERY MAN IS A VALUABLE MEMBER OF SOCIETY WHO, BY HIS OBSERVATIONS, RESEARCHES,
AND EXPERIMENTS, PROCURES KNOWLEDGE FOR MEN"—SMITHSON

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Secretary of the Smithsonian Institution.

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HOWARD, L. O. A history of applied entomology (somewhat anecdotal). November 29, 1930. 564 pp., 51 pls. (Publ. 3065.) (Whole volume.)

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 84 (WHOLE VOLUME)

A HISTORY OF APPLIED ENTOMOLOGY

(Somewhat Anecdotal)

(WITH 51 PLATES)

BY
L. O. HOWARD



(PUBLICATION 3065)

CITY OF WASHINGTON
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SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOL. 84. (Whole Vol.)

A HISTORY OF APPLIED ENTOMOLOGY

By L. O. HOWARD

ERRATA

- Page 53, line 12, from bottom, for "19" read "14."
- " 113, " 19, for "Southern" read "Eastern."
- " 149, " 1, for "J. H. Morgan" read "H. A. Morgan."
- " 201, " 9, from bottom, for "classifications" read "classification."
- " 228, " 7, for "Cambridge" read "Oxford."
- " 236, " 8, from top, for "Goreau" read "Goureau."
- " 280, " 18, from bottom, for "Caporal" read "Corporaal."
- " 281, " 3, for "U" read "H."
- " 281, " 15, for "T. A. Schoevers" read "T. A. C. Schoevers."
- " 281, " 26, for "G. F." read "J. G."
- " 281, " 29, for "Caporal" read "Corporaal."
- " 284, " 21, for "den" read "der."
- " 300, " 11, from bottom, for "Mamentov" read "Mamontov."
- " 304, " 1, for "first annual meeting" read "Second Congress."
- " 305, " 15, from bottom, for "N. F. Rimsky-" read "M. N. Rimsky."
- " 307, " 15, for "Nasunov" read "Nasonov."
- " 307, " 15, for "Kusnesoff" read "Kusnezov."
- " 322, " 5, from bottom, for "Dryenowski" read "Drenowski."
- " 330, " 12, from bottom, for "Escalara" read "Escalera."
- " 336, final paragraph: Townsend worked in the Gypsy Moth Laboratory on his return from the Philippines; and between his residences in Peru and Brazil worked in the U. S. National Museum for five years.
- " 356, " 16, for "Van" read "den."
- " 357, " 28, for "Kuchenius" read "Keuchenius."
- " 357, " 28, omit the second "J" in "C. J. J. van Hall."
- " 357, " 28, for "A. E. Rutgers" read "A. L. Rutgers."
- " 359, " 6, from bottom, for "Doctors" read "Docters." (Docters is part of family name).
- " 359, " 2, from bottom, for "Doctor" read "Docters."
- " 375, " 19, for "Secretary for" read "Director of"; for "Northern" read "Southern."
- " 416, " 4, under SAMOA, for "F" read "K."
- " 425, " 21, from top of page after "a" and before "German" insert "native Brazilian of" and after "German" insert the word "ancestry."
- " 440, " 8, from top, for "J. B. Poppe" read "Dr. James Pope."
- " 444, " 15, from bottom, for "H. W. Bates" read "Thomas Belt."
- " 502, " 2, from bottom, for "*montrousieri*" read "*montrouzieri*."

Page 548, omit "Betran, G. F." and add "281" to Betrem, J. G.

" 549, omit "Caporal, J. B."

" 550, for "Corporaal, J. D." read "Corporaal, J. B." and add "280, 281."

" 550, for "De Meijere, J. C. U." omit "U."

" 551, add "356" to "Den Doop."

" 551, for "Escalara" read "Escalera."

" 551, for "Dryenowski" read "Drenowski."

" 552, for "Friederich, Karl" read "Friederichs, Karl" and add "416."

" 552, omit "Friederichs, F."

" 555, for "Kuchenius" read "Kenchenius."

" 557, for "Morgan, J. H." read "Morgan, H. A."

" 560, for "Rutgers, A. E." read "Rutgers, A. L."

" 561, for "Schoevers, T. A." read "Schoevers, T. A. C."

" 563, omit "Van Doop."

" 563, omit the second "J" in "Van Hall, C. J. J."

Plate 1, fig. 2, for "1878" read "1879."

" 10, fig. 2, for "1852" read "1853."

" 10, fig. 4, for "1928" read "1929."

" 16, fig. 3, this is not Swammerdam, but Hartman Hartmansz.

" 20, fig. 2, for "1823" read "1828."

" 22, fig. 4, for "1807" read "1801."

" 42, fig. 3, add, after Boas, "(1855-)."

PREFACE

In January, 1928, I wrote the following lines as a preface to the history I was about to begin:

After studying insects nearly all my life and after having worked as an economic entomologist in the service of the Government for more than fifty years, I find that in an effortless way I have accumulated a lot of information which did not fit into anything I have published but which younger workers are constantly telling me ought to be put into print. There are hundreds of entomologists today where there was one fifty years ago, and in the soon-coming years there will be thousands, or I miss my guess. Why then should I drop off the stage before I have recorded certain experiences and impressions which, connected up with an historical account of the development of applied entomology, may be of much interest to many of the present younger workers as well as to thousands who are surely coming? I have no satisfactory answer to this question, and so I shall begin to write the pages that will follow.

It is now something more than two years since the above was written, and, while I have been deeply interested in gathering together what follows, I am not satisfied with it. It is bound to be criticised. It is not a history of the strict, modern, documented type. But it will be useful and I think that most entomologists will thank the Smithsonian Institution for publishing it.

L. O. HOWARD

May 29, 1930.

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A HISTORY OF APPLIED ENTOMOLOGY

(SOMEWHAT ANECDOTAL)

BY L. O. HOWARD

(WITH 51 PLATES)

INTRODUCTION

We need not concern ourselves with speculations concerning the damage done by insects to the food crops of ancient civilizations. Undoubtedly wherever a center of human civilization had its beginnings—just as soon as plant food began to be grown on a sufficient scale to feed many people—certain injurious insects began to increase in number. New opportunities for their increase were being offered to them—their increase was really being encouraged. If we had the records of lost civilizations, no doubt these losses by insects would appear.

Here and there significant things have been recorded by Herodotus, Pausanius, Theodoritus, Ammianus Marcellinus, Pliny and others. The downfall of the old Greek civilization has been attributed largely to the introduction of malaria (a mosquito-borne disease) by invading Persian armies. The shifting of the prehistoric civilizations of Central America may have been influenced largely by the occasional devastations of migratory grasshoppers. The prophet Joel records the woes of the ancient Hebrew farmers.

The rise of the nations of western and northern Europe, however, went on steadily. They were relatively free from the malaria scourge. Uncleanly personal habits and lack of sanitary arrangements, however, allowed the unhindered spread of another insect-borne disease—the plague—which in epidemic form from time to time carried off large percentages of the population. But the plague epidemics, the constant wars, typhus (another insect-borne disease), and other causes prevented rapid increases of population; the agriculture that grew up was one based on small holdings, and the loss through insects except occasionally was probably not excessive and was not appreciated. Comparatively little attention was paid to insect damage in Europe until within the last one hundred years, and even during the early part of that period the damage to forests was the item particularly stressed.

In the meantime that side of entomology which deals with the naming and classification of insects had been going on steadily and with an increasing number of workers. The great majority of these workers concerned themselves with the structure of the adult insects alone. Only here and there was to be found a man who studied the life histories and the early stages. These workers in taxonomy, as it is called, were scattered all over Europe, some of them connected with the large museums, others (and these were the majority) men in all walks of life who were attracted to the subject first as collectors and then as describers of species. The result was that in Europe before economic entomology began to be considered seriously, perhaps the great majority of the insects of that continent were to be found in the collections, had been classified, and had been given names. To a moderate extent the same statement applies to the other principal countries of the world. The European museums and collections contained thousands of species of exotic insects. Travelers in all parts of the world collected specimens and sent them home. Amateurs in some cases supported traveling collectors.

In the United States there were many amateur collectors and persons interested in the study of classification. In the early days it was necessary to send very many forms to the European authorities for identification, but as the years went on, large centers for systematic entomological work were started, skilled experts were developed, and by the time, for example, that Doctor Fitch began his work in New York there were already a number of American systematic entomologists who were perfectly competent to handle the American species and who had made such reputations that the European organizations took them very seriously and in some cases a little later elected a few of them to honorary membership in their learned societies.

When the economic entomologist began to appear he was frowned down upon by the systematic workers and considered on the whole to be an unscientific dabbler of the farmer class. This view held especially in European centers of learning, but it existed also in this country. With the rapid increase in the number of workers toward the end of the last century, however, with the enlargement of the departments of instruction in the universities and colleges, and with the admirable scientific work which was turned out by the applied workers, their status was soon established. In fact, there was evidenced on the part of some of the museum people a certain amount of bitterness at the larger salaries paid to the men working in eco-

conomic entomology; and at the same time there was, on the part of the economic workers, a feeling that the museum men and the other taxonomists were of comparatively slight importance.

All this, however, has passed away. Economic entomology has shown itself not only to be a most necessary study, but its workers, by the adoption of strictly scientific methods, have gained a high standing among the other scientific workers. Moreover, the economic workers, as the subject has broadened out before them, have come to realize that the work of the museum men is basic, that the work, in fact, of all men who study insects from any point of view is useful and that it is, in the last analysis, economic in its character. There has grown up a mutual respect among all classes of workers in entomology.

A little more than sixty years ago the grapevine *Phylloxera* disturbed Europe very greatly. The wine grape was threatened with extinction. Commissions were established in various countries, research was started, and modern European economic entomology really began.

Serious scientific work on problems of insect control in America began only a few years before this. The enormous expansion of agriculture in North America, the haste to grow enormous quantities of food in the quickest and the cheapest way, resulted in types of agricultural practice peculiarly favorable to insect increase, until we now realize that by our own labor we have been feeding constantly increasing myriads of plant pests and have been really responsible for their increase.

The situation that now confronts us is this: The population is increasing much more rapidly than the food supply. We must invent new food; or we must control the birth rate; or we must control ail waste. The enormous waste caused by insects is the most obvious and is the form of waste towards which our own Government and some others are now turning their serious attention.

The growth of economic entomology has been rapid, and its study is now expanding like the traditional snowball. Its real origin has been so recent that there has been no demand for a historical record of its growth. To be of permanent value, however, events must be recorded in some order at a time approximating that of their occurrence, if exact truth is to be preserved for the future. But a mere record is not enough. Causes, often deep causes, must be considered; and the interpretation of the mind and point of view of the earliest historian of a movement is in itself a part of the essential research of the later historian. Sir Arthur Keith in his address as President

of the British Association for the Advancement of Science in 1927 said,

To describe events and to give the order of their occurrence is the easier part of an historian's task; his real difficulties begin when he seeks to interpret the happenings of history, to detect the causes which produce them and explain why one event follows as a direct sequence to another.

The present account, as indicated in the preface, is not so serious as the professional historian would like it to be. The subtitle "Somewhat Anecdotal" indicates in a way the frame of mind of the writer, but there will nevertheless be here and there some attempts at interpretation.

For the past twenty-five years there has been a more or less conscious effort on the part of the writer to do four things: (1) To impress on everybody the enormous importance of the study of insects—that this study is one of vital importance to humanity; (2) To show all entomologists that, no matter what aspect of the subject they are studying, they are doing work of vital importance and are greatly helping mankind—this in the effort to prevent all friction between museum and laboratory men and economic workers; (3) To show the great body of scientific men that entomology and entomologists, including economic entomologists, are doing sound and important scientific work which should command their respect; (4) To bring about a solidarity among the entomologists of the world on the broad ground that the insect danger is one to all humanity regardless of national affiliation. This latter effort has perhaps been more successful than the others, although the conditions have become vastly better with all of them. The entomologists of the whole world, however, are now working in perfect harmony. The results of the work of all are speedily communicated to all the rest, and there are plans under way to bring about united effort on many problems.

I have enjoyed writing all this that follows, and as it approaches completion I realize that it has been quite worth while. It is a moderately full and moderately exact record of a branch of applied science that has sprung rather suddenly into existence and has developed with extreme rapidity to meet human needs. In doing it I have relied, for the American part, on my own memory supported by my own library and that of the Bureau of Entomology. For the portion relating to the rest of the world, I was, of course, by no means sure of my ground, and, although my personal acquaintance with entomologists around the world is very large and correspondence with them during fifty years infinitely larger, there have been great difficulties in bring-

ing together fair statements regarding work in many of the countries, especially possibly of the beginnings. I have gone through much printed matter with the purposes of this volume especially in mind, but there are language difficulties, and many important things are buried in official reports covering other branches of agricultural work. In some countries I have had admirable correspondents who have helped me greatly; in others I have evidently failed to find just the right man. By this I do not mean alone the man with the requisite knowledge, but the man who would take the time to help me when pressed with other duties. As a result, I fear that I may be thought to slight certain people and certain places. I would do much to avoid this if possible, but the time has come to consult the printer. If I have failed to do justice to certain countries, I will at least have done this much good, namely, to give an added incentive to some resident of such a country to do this narrative of the rise of economic entomology as he thinks it should be done.

Perhaps I should record here the long list of men in other countries who have helped me; but I have decided not to do so—the list would be too long. I extend to them collectively my deep gratitude, and have thanked them specifically in the sections relating to their respective countries. I must here, however, thank the Imperial Bureau of Entomology. It has helped me very greatly. Its invaluable *Review of Applied Entomology* is a publication which helps all of us all over the world. The language difficulties just mentioned vanish before the Bureau's corps of linguists; and the Director, Doctor Marshall, and his principal assistant, Doctor Neave, are courtesy and helpfulness personified.

As just indicated, there are several countries which, I realize abundantly, are not treated satisfactorily here. I am not satisfied with the apologetic general statement, but may insert individual apologies in places where they will count more.

And now let us look at the story of the growth of our knowledge of what the British call applied entomology but we in the United States, at least down to the present time, have been calling economic entomology.

PART I
NORTH AMERICA

NORTH AMERICA

THE UNITED STATES

EARLY HISTORY AND EARLY AMERICAN WRITERS

The crops of the early colonists in America apparently did not suffer seriously from the attacks of insects. The growth of agriculture was relatively slow. The opportunities for the introduction of new insect pests from other countries were practically non-existent. Apparently very few native insects changed their habits and took to cultivated crops.¹ During the Revolutionary War and shortly afterwards, five or more injurious insects began to attract attention. Around Boston a native species damaged squashes and pumpkins to such an extent as to cause general attention and much vituperation which expressed itself in the popular name which Bostonians gave to it—the Gage bug, after the much hated British general in charge of the forces of occupation in that region. The so-called Hessian fly, a species of European origin, began to be noted after this period, and was similarly given an objurgative popular name. Two more European pests were introduced either during this period or shortly before, namely the codling moth (a name gained from England), which is the cause of wormy apples, and the so-called Angoumois grain moth, or “fly weevil,” the latter becoming serious in the Carolinas and Virginia, having possibly been introduced in the grain supplies of troop ships. The latter insect had done much damage in France and derived one of its popular names from the province of Angoulême. The chinch bug, a native insect, was apparently first noticed in North Carolina at the close of the Revolutionary War, where it was mistaken for the Hessian fly which at that time was attracting considerable notice on Long Island and thereabouts. It continued to do considerable damage for several years in North Carolina, South Carolina, and Virginia, and again became very destructive in North Carolina in 1809.

A little book entitled “The Wonders of Nature and Art,” by the Rev. Thomas Smith, revised by James Mease, M.D., was published in Philadelphia in 1807. It contains a long chapter on insects, in which account is given of the seventeen-year locust, of the Hessian fly, and, following a memoir by Doctor Barton, some account,

¹ See F. M. Webster, Early published references to some of our injurious insects. *Insect Life*, Vol. 4, pp. 262-265, March, 1892.

under 16 headings, of various insects among which may be recognized chinch bug, pea weevil, blister beetle of potatoes, cankerworm, plum curculio, peach-tree borer, cucumber beetle, and squash bug. In addition, an account is given of the cotton caterpillar and of an unknown pine-tree borer said to have caused the death of great numbers of pine trees in South Carolina.

J. D. Tothill has studied the history of the early outbreaks of the forest tent caterpillar (see Report of the Entomological Society of Ontario, 1917). He shows that Smith and Abbot stated in 1797 that this insect, "is sometimes so plentiful in Virginia as to strip the oak trees bare." He also states that as early as 1791 there was an outbreak of an insect in Vermont, which was probably the forest tent caterpillar.

As time went on there was a rapid extension of agriculture toward the West, and the rapidity of its extension increased with each decade; the cultivation of new crops was begun, and new pests were brought in from foreign countries, at first slowly, but in gradually increasing numbers.

As agriculture expanded, agricultural newspapers began to be founded and from time to time published articles dealing with insect problems; and naturally the attention of a few able men was drawn to the real study of insects from the practical point of view.¹

It is interesting to note that from 1771 until 1880 (more than a hundred years) there were only 60 men in the whole of North America who wrote worth-while notes or articles on injurious insects (six of the sixty were Canadians). Between 1771 and the outbreak of the Civil War there were only 23 such writers. During the war three more began to write, and before 1870 ten more. Between 1870 and 1880, 23 additional writers had published on one phase or another of the subject.

Comparatively few of these writers were competent entomologists. Some were farmers or fruit-growers, others were physicians, and others were teachers. None received compensation for their work until T. W. Harris was given a small sum for the preparation of a report on the injurious insects of Massachusetts in 1841; and the first official entomologist to be appointed was Asa Fitch in New York in 1853; T. Glover received the first Federal appointment in 1854.

¹ Prof. F. M. Webster published an article in *Insect Life*, Vol. 4, pp. 262-265 and 323-326, March and June, 1892, in which he mentions a number of important observations recorded in early numbers of the *American Farmer*, *Farmers' Cabinet*, the *American Journal of Science*, and *The Cultivator*.

Priority in this list apparently belongs to Colonel Landon Carter of Virginia, who published in the Transactions of the American Philosophical Society for 1771 a rather long paper entitled "Observations concerning the Fly Weevil, that Destroys the Wheat, with Some Useful Discoveries and Conclusions regarding the Propagation and Progress of that Pernicious Insect, and the Methods to be Used to Prevent the Destruction of the Grain by It."

The second important contributor to this kind of literature was Prof. William D. Peck, of Harvard College, whose first article was "The Description and History of the Canker Worm" (Massachusetts Magazine, 1795). He described the species as *Phalaena vernata* (the spring cankerworm). He published later papers on the natural history of the slugworm (*Selandria cerasi*), 1799; on the cankerworm again, 1816; on the insects which destroy the young branches of the pear tree and the leading shoot of the Weymouth pine (*Scolytus pyri* and *S. strobi*), 1817; and the insect which destroys the locust tree (*Cossus robiniae* and *Clytus robiniae*), 1818. His last published paper was upon insects which affect the oaks and cherries, 1819. In this article he described the oak pruner and the plum curculio.

Continuing chronologically, R. Green wrote about the horse bot as early as 1806, and published other papers on the rose-chaffer and on cutworms.

The famous entomologist, Thomas Say, wrote about the Hessian fly as early as 1816. He published three short papers on this insect; another in 1823 about the peach-tree borer, and in 1828 a letter written by him to C. W. Capers contained the first scientific description of the adult of the famous cotton caterpillar.

In 1823 was published the first economic paper by the man who is held to have been the father of economic entomology in America—T. W. Harris. It was entitled "Upon the Natural History of the Salt Marsh Caterpillar." Harris continued to write until 1860, and his contributions were so numerous and so important that they will be considered in a separate section to follow this running account.

E. C. Herrick, Librarian of Yale College, published his first economic note in the American Journal of Science and Arts for 1840, describing an egg-parasite of the spring cankerworm. Later in the same journal, 1841, he published an account of the Hessian fly and its parasites, considering this insect in both its European range and its American range. A longer article by the same writer on the subject of the Hessian fly was published in the Report of the Commissioner of Patents for 1844.

B. H. Coates published five papers in 1841 on the Hessian fly.

Miss Margaretta H. Morris began to write on entomological topics in 1841 and continued until 1860. Her writings were for the most part popular and not very well founded, although she was looked upon at the time as an authority.

Willis Gaylord in 1843, in the Transactions of the New York State Agricultural Society, published a rather pretentious work covering nearly 50 pages, with three plates, under the title "A Treatise on Insects Injurious to Field Crops, Fruit Orchards, Vegetable Gardens, and Domestic Animals; With a Description of Each and the Best Methods of Destroying Them or Preventing Their Ravages." Some 50 species are considered in this work. It seems to be little more than a good compilation from Say, Kollar, Harris, and a few others and from such papers as had been published in the American Journal of Science, the New England Farmer, the old Genesee Farmer and the Albany Cultivator, although in his preface the author states that he has added such corroborative or original facts "as the experience and observation of some 40 years spent on a farm may have afforded." The illustrations are fairly good, but there seems to be nothing novel in the way of remedial suggestions.

The next writer to appear on the entomological horizon was no less a person than Dr. Asa Fitch, of New York, a man who played a great part in the development of the science in America. In 1845 his first paper, entitled "Insects Injurious to Vegetation, No. 1," was published in the Quarterly Journal of Agricultural Science, and four subsequent articles under the same title were published in the same journal during the next two years. These and subsequent articles attracted much attention, and in 1854 he became the first State Entomologist. His work and his influence were so important that a fuller account is reserved for later pages.

In 1847, S. S. Haldeman, a very competent naturalist, published his first paper on economic entomology, in which he treated of the habits and ravages of *Agrilus ruficollis*.

In the same year Edmond Ruffin, a Virginian and a man of vision and high rank in agriculture, wrote upon the Angoumois grain moth in the American Agriculturist.

In 1850 another excellent entomologist appears. Dr. J. A. LeBaron, afterwards a very prolific writer and the second State Entomologist of Illinois, published in the Prairie Farmer for September, 1853, some "Observations upon Two Species of Insects Injurious to Fruit Trees." In this paper he gave a description and an account of the injuries of *Tettigonia mali*, and an account of the history of the leaf-

crumpler (*Acrobasis indiginella*). He continued to write for the *Prairie Farmer* for many years upon all sorts of subjects relating to economic entomology. Following the death of B. D. Walsh in 1869, he was appointed State Entomologist of Illinois, and his first report was published in 1871. He continued to publish in the *Prairie Farmer*, but died shortly after the appearance of his Fourth Annual Report in 1874.

In 1852 an important article entitled "The Cotton Worm; Its History, Character, Visitations, etc." by Dr. D. B. Gorham, appeared in De Bow's *Industrial Resources*. It was a very competent account of the natural history of *Alabama argillacea*, describing its principal parasite and introducing the theory of the migration of this insect from the South. It appears that this article had previously been published in De Bow's *Commercial Review* for 1847 and in the *Southern Cultivator* of the same year.

An important article was published in 1852, in the *Southern Planter* (pp. 271-272), by Prof. J. L. Cabell of the University of Virginia, which has apparently been overlooked by Henshaw in Part IV of the "Bibliography of American Economic Entomology." It is entitled "Joint-Worm," points out the existence of a parasite, and demonstrates the fact that damage is actually done by "*Eurytoma hordei*" which, since it belongs to a parasitic group, had been considered by many to be a parasite and not on any account to be considered a plant-feeder. The writer was familiar with the work of Harris and of Fitch. The same volume of the *Southern Planter* contains another article (a long one) by a close observer of the insects affecting the wheat crop, who signs himself simply "Anon."

The next writer in chronological order was Dr. W. I. Burnett, a Boston physician who had gone south for his health and who wrote about the cotton-worm and the cotton boll weevil independently, suggesting the migration theory, and whose first article was published in the *Proceedings of the Boston Society of Natural History* for January, 1854.

In 1854 also appeared the first publication by Townend Glover, who for so many years was Entomologist to the Federal agricultural service. His first report, entitled "Insects Injurious and Beneficial to Vegetation," was published in the Report of the U. S. Commissioner of Patents for 1854, Agriculture, 1855. Glover's work deserves much more detailed mention and will be considered subsequently.

In 1857 F. G. Sanborn, of Massachusetts, began to write on economic entomology. His first recorded paper was published in the Fifth Annual Report of the Secretary of the Massachusetts State

Board of Agriculture. In it he described the habits of several insects injurious to fruit and shade trees. He was employed in the Massachusetts State Cabinet of Natural History at the State House in Boston, and was clerk to C. L. Flint, the Secretary of the Massachusetts State Board of Agriculture, who edited the final edition of Harris' "Insects Injurious to Vegetation." Later he was employed in the Museum of the Boston Society of Natural History, and came to Washington in the winter of 1875-76 to prepare the collection of insects injurious to vegetation which was exhibited by the Department of Agriculture at the Centennial Exposition in Philadelphia in 1876. This collection was still in existence in the Department at Washington when the writer arrived here in the fall of 1878, and is referred to on other pages. Sanborn also contributed to the Tenth and Twelfth Annual Reports of the Secretary of the Massachusetts State Board of Agriculture and wrote a few other economic articles in agricultural journals.

In 1859 a new writer published his first entomological article. This was the Rev. Cyrus Thomas, of Illinois, who wrote about the chinch bug in the *Prairie Farmer*. Professor Thomas continued to write on entomological topics in the *Prairie Farmer* and the *Illinois Farmer* for a number of years; and in the *Transactions of the Illinois State Horticultural Society* for 1877-78 published a rather lengthy article covering a number of injurious insects. Thomas had been a lawyer prior to 1865. He then became a preacher in the Lutheran Church; then a teacher of natural science, and then State Entomologist of Illinois.

In 1877 the United States Entomological Commission was founded by Act of Congress. Thomas was appointed a member, with C. V. Riley and A. S. Packard, Jr. The work of the Commission will be described on a later page. In 1877 was published his first biennial report as State Entomologist of Illinois. He was appointed to this position following the death of Doctor LeBaron. Six of these reports by Thomas were published, the last one appearing in 1882. They were very interesting and rather valuable reports. He was the first of the state entomologists to include in his reports articles written by assistants. John Marten, Miss Nettie Middleton, D. W. Coquillett, and G. H. French are the authors of articles in the fifth and sixth reports. Thomas continued to write on entomological topics until 1882, when he was succeeded in the office of State Entomologist by Dr. S. A. Forbes. Immediately after this he turned his attention to ethnology and eventually became connected with the Bureau of American Ethnology, under the Smithsonian Institution, a position which he held until his death.

I had the pleasure of meeting Thomas in the winter of 1878 when he visited Washington for consultation with Riley concerning the operations of the Entomological Commission. He was a keen-faced, kindly man. The years dealt kindly with him, and he was not greatly changed when years later he called at my office, long after he had lost his interest in entomology. At the time, he was 84 years of age, but mentally as active as ever. He came in to suggest the idea that certain non-migratory grasshoppers, after a succession of dry seasons, grow longer wings and become migratory. He went on to say, "J. G. Morris came into my laboratory once years ago when Darwin's book on the origin of species was first making such a stir, and while he was objecting to the whole idea of evolution, I told him about the grasshoppers; and he said, 'Thomas, what are we coming to?'" You can imagine the scene: these two ex-ministers of the Gospel, having the advantage of other members of the cloth in being naturalists, puzzling their brains already in the effort to harmonize the facts of nature with the teachings of the church.

In the year 1860 three new writers on economic entomology appeared. The first was Benjamin D. Walsh, of Illinois, a man of extraordinary ability as an observer, as a writer, and a philosopher. His influence upon the development of economic entomology in the United States was so great that special consideration will be given to him in a subsequent section.

Thomas Meehan, whose first entomological paper appeared in 1860, wrote principally for the *Gardeners Monthly*. He was an Englishman by birth and was trained as a horticulturist at Kew Gardens. He came to America at the age of 22 (in 1848) and remained for the rest of his life at Philadelphia. He held the position of State Botanist in Philadelphia and was a member of the Board of Visitors of Harvard University. His first entomological publication related to red spider on pear trees. Apparently he wrote nothing of importance in this direction during the next 10 years, but beginning with 1870 he published frequently in the *Gardeners Monthly* about different insect pests until 1877.

The third writer beginning to publish in 1860 was Dr. S. S. Rathvon, of Lancaster, Pa. He was a tailor by trade, but was a born naturalist and had collected and studied insects from early youth. His serious work with entomology began when Prof. S. S. Haldeman discovered that he was interested in insects. His first published paper on economic entomology did not appear until he was 42 years old. It was entitled "Entomological Essay" and was read before the Fruit Growers Association of Eastern Pennsylvania in June, 1860,

and published in the *Gardeners Monthly* for October, November, and December of that year. It considered a number of injurious Coleoptera, and was evidently the result of careful observation. He had published about insects before this to a slight extent, and in fact there is a recorded newspaper article of August, 1854, on the cottony cushion scale. Doctor Rathvon continued to work and to publish about injurious insects, mainly in farmers' and gardeners' journals, until 1880. He died in 1891. His title of doctor was not gained until late in life; the Ph. D. was given to him in 1878 by Franklin and Marshall College for his long and important work. In 1869 he assumed editorial charge of the *Lancaster Farmer*, continuing until the journal suspended in 1884. In the columns of this periodical he is seen at his best as a scientific writer.

Townend Glover having temporarily left the United States service in the early 1860's, Doctor Rathvon contributed to the United States Agricultural Reports for 1860 and 1862, two illustrated papers which treated of the several orders of insects in a popular manner.

One of the most famous of American entomologists began to write on economic entomology in 1861 judging by the record given in the "Bibliography of American Economic Entomology." This was Dr. A. S. Packard, Jr., and the first contribution, just indicated, was entitled "Entomological Report on the Army Worm and Grain Aphis," in the Sixth Annual Report of the Maine State Board of Agriculture. We learn, however, from the very full biographical memoir of Packard by T. D. A. Cockerell, published in Volume 9 of the *Memoirs of the National Academy of Sciences*, that in 1860 Packard wrote papers on economic entomology for the *Maine Farmer*. From that time until his death in 1905 Packard was an inveterate worker and prolific writer. His bibliography includes 579 titles, very many of which relate to economic entomology although he was a very broad entomologist and published mainly upon other aspects of the science—in fact, upon other aspects of zoology. There are, however, 58 titles of articles which may be termed economic.

Packard held many positions in the course of his life, and in fact published three annual reports on the injurious and beneficial insects of Massachusetts (1871-3). With Riley and Thomas, he was a member of the United States Entomological Commission, and therefore co-author of most of its reports and bulletins. His most important personal work connected with the Commission was his bulletin (No. 7) and his large report (the Fifth Report of the Commission) on insects injurious to forest and shade trees. These publications, while very largely compilations, contained very many previously unre-

corded observations, and have been found to be very useful compendiums. He also prepared a report upon "Insects Affecting the Cranberry, with Remarks on Other Injurious Insects," which was published in the Report of the U. S. Geological Survey for 1876, 1878.

Packard lived a very useful life and was counted one of the foremost men in zoology in America. He was a member of the National Academy of Sciences, an honorary member of the Entomological Society of France, and an honorary fellow of the Entomological and Linnean Societies of London. His great "Guide to the Study of Insects," published in 1869 and republished in several editions, was for many years the standard book on this subject in the United States and was constantly consulted by all American entomologists.

Doctor Packard's personality was very attractive. He was charmingly courteous to younger workers. His faulty palate, although it was the cause of some embarrassment to him and made him appear at first rather unapproachable on account of his disinclination to talk at length, nevertheless did not prevent him from lecturing in an impressive and interesting way. His influence in the development of applied entomology in America was probably greater than that of any other man who did not virtually devote his whole time to this work. Professor Cockerell, in his charming biographical memoir just referred to, mentions a curious personal peculiarity which I think I told to Cockerell. It was in the way of economizing paper. He would write his manuscript on any scraps of envelopes, wrapping paper and so on that were available. These were numbered and constituted his manuscript. Considering this peculiarity together with Packard's not too legible handwriting, one can imagine the difficulty I had in editing the big report on "Insects Affecting Forest and Shade Trees" with its 957 pages. Cockerell mentions incidentally that the famous English entomologist, Professor Westwood, had this same habit; and this reminds me that when Westwood died (in 1893) Doctor Packard was spoken of as his possible successor to the Hope professorship of entomology at Oxford. I remember that C. V. Riley was also an ardent candidate for the same position and that he personally solicited the interest of certain of the authorities upon whose votes the position depended, and that at one time he was quite certain that he would receive the appointment. That Professor Poulton got the place was a great disappointment to Riley, although Doctor Packard, I feel sure, was quite content with his very agreeable post as Professor of Zoology and Geology at Brown University.

Another entomologist who was to become famous began to publish on economic entomology at about this same period. Mr. S. H. Scudder published some notes on white ants in the Proceedings of the Boston Society of Natural History, in June, 1860; and the following year, in the same Proceedings, published an account of a destructive aphid and the army worm. Although as boys Packard lived at Orono, Maine, and Scudder at Boston, they began to correspond before college days on the subject of entomology. Later they came together at the Agassiz Museum, and each followed a career of distinction, ultimately achieving very high reputations and receiving many foreign honors. Scudder did not concern himself so much with economic entomology as did Packard. Nevertheless, he published more than a dozen articles of more or less importance and of an economic character. He was the first man to make a comprehensive study of the progress of an injurious species introduced from Europe. His paper, entitled "The Introduction and Spread of *Pieris rapae*¹ in North America, 1860-1886," was published in the Memoirs of the Boston Society of Natural History, Volume 4, 1887. As the result of this study, we understand the spread of this injurious insect at that early date quite as well as we understand now the spread of those much later immigrants, the cotton boll weevil, the gipsy moth, the San Jose scale, the alfalfa weevil, and the European corn borer.

All through his life Scudder was most helpful to the economic entomologists who were coming up. He was versed in the literature of entomology; he was an authority upon the diurnal Lepidoptera and upon the Orthoptera, and was of the greatest help to many of us. He was a delightful, scholarly man personally, and a charming writer. In addition to the two fields mentioned, he did much work with fossil insects and published elaborate and well illustrated papers in this field.

This reminds me of an anecdote: When Filippo Silvestri first visited this country (in 1908) he had done much work on fossil Myriapods, and one day while at Boston he was asked by W. F. Fiske and, I think, A. F. Burgess if he would like to see Scudder's types of fossil Myriapoda. They took him to Cambridge, and, with Scudder's permission (the latter was lying paralyzed at that time), showed him the type specimens. He examined them and made no comment, until finally Fiske said, "What do you think of them?" The story is that he replied, "I sink zay are all caturplars." It was some time before Fiske figured out that he meant *caterpillars*.

¹ Now the common cabbage butterfly.

Scudder, Packard, J. L. Leconte, and Horn stood out in their generation as the most distinguished American entomologists.

A complete and beautiful account, by A. G. Mayor, of Scudder's life will be found in *Memoirs of the National Academy of Sciences*, Volume 17, pp. 81-103.

C. V. Riley's first papers were published in the *Prairie Farmer* for 1863. The importance of his work is so great that it will be separately considered on later pages.

In 1864 appeared the first article by Dr. Isaac P. Trimble. Doctor Trimble was a successful fruit grower, whose first contribution to entomology was published in the *Proceedings of the American Pomological Society* of that year. It considered the codling moth and the plum curculio. Altogether there are nine titles of record under his name. The most pretentious one is a quarto volume of 139 pages, illustrated by very fair plates, entitled "A Treatise on the Insect Enemies of Fruit and Fruit Trees," published in 1865, apparently as a private publication.

According to H. B. Weiss, the Report of the Executive Committee of the New Jersey Agricultural Society for 1866 states that the legislature had appropriated three thousand dollars to the Society for preparing and publishing this treatise of Doctor Trimble's and that the money was to be paid in yearly installments of one thousand dollars. It was further stated that none of this money went to the author but was used by the Society in publishing and purchasing copies of the book for distribution. "Eight dollars were asked for a copy with colored plates, and five dollars for one without colored plates." Doctor Trimble was 61 years old at the time of publication of this book; and he lived to be 86. W. G. Johnson (*Proceedings of the Entomological Society of Washington*, Vol. 4, pp. 230-233) states that Doctor Trimble had planned two additional volumes and that many of the plates were prepared and that these and other illustrations had come into his (Johnson's) possession. In the opinion of Mr. Johnson, the work that Trimble did alone and unaided "entitles him to a prominent place with the early economic entomologists of this country."

In 1865 three new writers appeared in the field of agricultural entomology. A. E. Verrill, afterwards a famous zoologist and head Professor of Zoology at Yale University, published that year in the *Practical Entomologist* a note on the woolly root-louse of the apple. Five years later he published two long papers on the external and on the internal parasites of domestic animals, in the *Fourth Annual Report of the Secretary of the Connecticut Board of Agriculture*, following

this with a paper giving additional observations on the same subject in the Fifth Report (1872).

G. E. Brackett, of Maine, published an article on parasites in the same volume of the Practical Entomologist, and in 1866 began an interesting series of articles entitled "Practical Entomology," published in the Maine Farmer beginning May 3, 1866. Twenty-two of these articles, covering in all a large number of topics, were published between that date and October 18. He published four additional articles in the same journal the following year.

Dr. Henry Shimer, of Mt. Carroll, Illinois, a country physician of the old type and a man of much scientific acumen, began to publish on entomological topics in the Prairie Farmer of July 1, 1865. In the next six years he published 25 longer or shorter articles, in the same journal, in the Practical Entomologist, in the Proceedings of the Academy of Natural Sciences of Philadelphia, in the Transactions of the American Entomological Society, and in the American Entomologist and Botanist. Doctor Shimer was a very versatile man and a very broad student. He did not hesitate to describe new species, although his library facilities were very small. He was one of the early students of the grapevine Phylloxera in America, and in fact erected in 1866 the genus "*Daktulosphaira*" for the leaf-gall form. He was a large man of impressive personality, with the abundant hair and long beard common at that time. I remember him well when he called on two occasions in the offices at Washington. His outdoor life had given him the appearance of a well-to-do farmer, rather than that of a professional man.

Two years later, 1867, appeared the first paper by a writer who was destined to become prominent in the field of economic entomology. This was Prof. A. J. Cook, of Michigan. That year he wrote in a journal known as the Western Rural on the habits of the oak caterpillar (*Dryocampa senatoria*), which was followed the next year by another article on the same insect for the same journal. At that time he was Professor of Zoology in the Michigan Agricultural College, where he remained until 1894. During his Michigan period he was a prolific writer, and is the author of 78 recorded papers on many aspects of economic entomology. He was not a learned entomologist, but he was a good lecturer and teacher—in fact one of the very earliest to teach entomology. He was an excellent popularizer of the subject, and with his practical mind and charming address did a great deal of good as a lecturer before farmers' institutes. In 1894 he left Michigan and went to Pomona College in southern California. There he built up an excellent depart-

ment of entomology and trained some admirable students. By good luck, he was able to attract the late Carl F. Baker, one of the most enthusiastic workers and collectors American entomology has ever seen. I stopped at Pomona once in the late nineties and found that Professor Cook had taken off his beard and had become young and active and most enthusiastic. There was a spirit of vigor about the institution that was very pleasing. Part of this was doubtless due to Baker, but Professor Cook's personality seemed to have been completely changed. He published 17 economic papers during the next two years, became well known as a speaker at the fruit-growers' conventions. He published 30 or 40 additional papers during the following years, and in 1912 was made State Commissioner of Horticulture. His selection for this post proved to be an excellent one. California emerged from the fog of parasite control that had dominated her economic entomology for a large part of the previous 25 years, and began to do up-to-date work based upon sound scientific principles. Harry S. Smith was taken over from the Federal service, and for the first time California had an expert trained in parasite matters in charge of that department of work.

I realize that the last sentences convey, on the whole, too derogatory an impression. It must not be forgotten that California was the first State of the Union to pass proper pest laws and to set up a rigid quarantine, and that all of the early laws passed by other States were based upon those of California. California, in fact, led the Federal Government in this direction by 15 years.

Professor Cook, by the way, was one of the founders of the Association of Economic Entomologists and was one of the nine men present at the memorable field meeting at Toronto in 1888, and, in fact, presided.

An interesting episode connected with his work in Michigan was the rather vigorous discussion that took place between him and Professor Riley on the subject of kerosene emulsion. Cook used kerosene and soap solution as early as 1877, first recommending it to the public in 1878. In 1880 Riley recommended the kerosene and milk emulsion. Later, Hubbard produced a formula for kerosene-soap which differed from that recommended by Cook. The most conflicting evidence appeared relative to the success of the two formulae, and a controversy arose which was finally settled by a visit which C. L. Marlatt made to Michigan at Riley's instance; and the simple explanation was found in the character of the water used in Michigan, which was very strongly alkaline.

It is interesting to note that in Professor Cook's Bulletin No. 76 of the Michigan Station, he stated that he found that Henry Bird¹ of Newark, New Jersey, as early as 1875 advised mixing a little kerosene oil with strong soapsuds. Mr. Bird apparently made the first kerosene-soap emulsion.

Professor Cook died in office September 29, 1916.

Andrew S. Fuller was a well known horticulturist who naturally became interested in economic entomology and published his first papers on this subject in 1868. He wrote altogether 22 papers relating to this subject, probably the most important one being his account of "The Insect Enemies and Diseases of our Small Fruits" published in the March, April, and May numbers of the third volume of the *American Entomologist* in 1880. Mr. Fuller was a prolific horticultural writer, and at different times was editorially connected with the *Rural New Yorker*, the *New York Tribune*, *The Agriculturist*, and *American Gardening*. His book, "Small Fruit Culturist," was one of much importance and was translated into German for publication in Weimar. At one time he was part owner of the *Rural New Yorker*. He was a man of broad interest in natural science, and, among other large collections, he built up a collection of Coleoptera. *Aranigus fulleri*, popularly known as Fuller's rose beetle, was named after him by Doctor Horn.

In the same year were published the first contributions to economic entomology by Hermann Hagen and Samuel Lockwood. Doctor Hagen will be written about in a subsequent section. Rev. Samuel Lockwood was one of the very few ministers of the Gospel who have written about injurious insects. His first contribution was on "The Goldsmith Beetle and Its Habits" (*American Naturalist*, June, 1868). He published in all six papers, all in the *American Naturalist* with the exception of an "Account of the Invasion of 1880 in New Jersey," relating to grasshoppers, which appeared in the Annual Report of the United States Department of Agriculture for 1882.

Mrs. Mary Treat, who began to write in 1869, was a person who was very fond of the study of entomology, and early began to write in the *American Entomologist*. Her principal work was not published, however, until 1882, when she issued a book entitled "Injurious Insects of the Farm and Garden" which covered 288 pages, with 163 figures. It is an attractive little volume, very largely compiled from Riley's reports and that of Comstock for 1879, but making a

¹ No relation of Henry Bird of Rye, New York, now (1928) President of the New York Entomological Society.

very useful compendium. Riley himself thought of publishing a volume of this general character, but never did so. As a matter of fact, the text of Mrs. Treat's book is very largely in Riley's words. Reëxamining it recently, I noticed first some of his extremely characteristic expressions, and next that Mrs. Treat is occasionally referred to in the third person. Then, comparing closely, I found that whole pages were copied without quotation marks from Riley's Missouri Reports. The fact that the author "largely availed herself" of Riley's writings is mentioned in both the publisher's and the author's prefaces, but surely the authorship of the book should at least have been stated to be Riley and Treat. None of the illustrations are original, and the original sources are not mentioned. Most of them are from Riley, and I think that the publishers (Orange Judd Company) bought the electrotypes from him.

The American Entomologist, a publication about which we must give some details later, was responsible for the appearance of a number of new writers at that period (1869-1870). Prof. J. Parish Stelle, of Savannah, Tennessee, was the author of a note on Cicadas in the January number of that journal (1870). He wrote a number of articles that were published in this magazine, and later published a number of very interesting articles in southern newspapers in regard to the cotton caterpillar and other entomological topics. In his later life he was agricultural editor of the Mobile Register, in which some of his articles were published.

In the same year (1870) Dr. J. A. Lintner, who was to become a very prolific and important writer, published his first paper in an Albany newspaper. It related to the imported cabbage worm. Lintner proved to be an important figure in the development of economic entomology in the United States. He was of German descent and was originally a manufacturer of woolen goods. As early as 1853 he began to collect insects, and published his first entomological article in 1862. In 1868 he became a zoological assistant in the State Museum at Albany, and was put in charge of the entomological work in 1874. In 1880 it became necessary for the then Governor of New York to appoint a State Entomologist to take up the work which Dr. Asa Fitch had followed until his illness and death. Doctor Lintner received the appointment.

I have never told this story, but, as it happens, one of my uncles was a wealthy New Yorker, interested in politics, and a member of the Union League Club. I had known Governor Cornell from childhood, and my uncle wrote me and asked me whether he should recommend me for the Albany position. I had then been in Washington

less than two years; I knew Doctor Lintner's high standing and sound work, and wrote to my uncle that he should not make the suggestion since the place belonged to Doctor Lintner.

From 1870 until his death in Florence, Italy, in 1898, Lintner sent out a perfect stream of publications. His bibliography covers more than 900 titles. It is true that very many of these were newspaper articles, although published in journals of high class like the *Rural New Yorker* and the *Country Gentleman*, but many of them were important; and his larger publications, notably his "Entomological Contributions" published by the New York State Cabinet of Natural History, contained very many separate articles of high rank, and his twelve reports on the injurious and other insects of the State of New York are models. He had no laboratory facilities (all of his work was done in his office) and original investigations in applied entomology were almost impossible. So these reports are largely compilations and the results of correspondence and of such rather limited observations as he could make in the field. Nevertheless they are models. No other reports that have been published excel them in care of preparation, lucidity of style, bibliographical detail, fullness of indices, and general consultability. When Lintner wrote about an insect, it was certain that he had overlooked nothing that had previously been done, and his papers were the latest words on that topic. He was a man of very fine appearance, an impressive speaker and lecturer, and of great personal charm, dignified, well dressed, in fact a man who by his personality helped much to dignify the profession. It always seemed to me that Harris must have been much of the same type. I said as much to Lintner once, and it embarrassed him greatly. He answered in very courteous words, but the idea I gained was that he thought me foolishly fulsome.

In 1871 the first economic papers by C. R. Dodge and A. R. Grote were published. C. R. Dodge is mentioned in the later account of Townsend Glover, as his biographer. A. R. Grote was a famous taxonomist and broad naturalist, but devoted most of his time to the study of the moths in the family Noctuidae. His principal invasion of the economic field centered around the southern cotton caterpillar, about which he wrote five articles between 1871 and 1875. He was a strong advocate of the migration theory in regard to this insect. During this period he came to Washington and advocated a government appropriation for the investigation of this insect. Later he wrote seven other articles of an economic bearing, the principal one relating to the pine *Nephopteryx*. It is interesting to note that in 1879 he vigorously opposed the use of Paris green as an insecticide,

on account of its liability to injure domestic animals. He died in Germany in 1903. He was not only an entomologist of high rank, but a philosopher, a writer, a poet, and a musician of accomplishments.

In 1872, C. E. Bessey, Mary E. Murtfeldt, and D. B. Wier entered the field. Professor Bessey became a famous botanist and, toward the end of his life, the President of the University of Nebraska and President of the American Association for the Advancement of Science. In his early days he was living in Iowa and wrote 11 papers treating of applied entomology, his first article treating of the Colorado potato beetle. Between 1871 and 1875 he prepared and published four reports on injurious insects—the first two published by the State Horticultural Society of Iowa and the last two by the State Agricultural Society of Iowa. D. B. Wier was a fruit-grower who published only four articles. His principal contribution was entitled "Native Plums. How to Fruit Them. They are Claimed to be Practically Curculio Proof." This was published in Bulletin 14 of the Division of Entomology of the United States Department of Agriculture.

Miss Mary E. Murtfeldt was an amateur entomologist who lived at Kirkwood, Missouri. She was an educated, charming lady, who met Professor Riley when he first went to Missouri in 1868 and who was much influenced by him in her entomological studies. Later when he came to Washington she was made a field agent of the Bureau and wrote several reports on the insects of that part of the country. Beginning with a short paper published in the *Canadian Entomologist* for August, 1872, she continued to write on different topics nearly until her death in 1913. Aside from economic entomology, she was particularly interested in the study of the leaf-rolling caterpillars (family Tortricidae).

It is generally forgotten that Dr. John L. Leconte, the great coleopterist, wrote eight papers on topics relating to economic entomology, and that as early as 1873 he published a paper entitled "Hints for the Promotion of Economic Entomology in the United States."

In 1874 the first entomological papers by F. M. Webster, T. J. Burrill, E. W. Claypole, A. W. Hoffmeister, and H. G. Hubbard were published. Webster's was a short article in a Chicago newspaper, but his first article of importance was not published until 1880 when his interesting "Note on the Food of Predaceous Beetles" was printed. He was a farmer's son, and at first a farmer himself, and he became an entomologist from the necessity of studying farm pests. He was not a college-trained man, but was a keen observer, and eventually became one of the most prominent figures in Ameri-

can applied entomology. He was for a time connected with agricultural experiment stations in Illinois, Indiana, and Ohio, and eventually came to Washington in 1904, where he became the head of the section of Cereal and Forage Crop Insects in the Bureau of Entomology, dying in harness in 1916. He was a prolific writer and an excellent observer. Some of his papers were of much importance. One of the most striking results of his studies was the discovery (while he was a field agent of the Federal entomological service) of parthenogenesis, dimorphism, and alternation of generations in the genus *Isosoma*. Webster's bibliography covers rather more than 600 titles. One of the very best of his papers is Bulletin 42 of the Division of Entomology, entitled "Some Insects Attacking the Stems of Growing Wheat, Rye, Barley and Oats, with Methods of Prevention and Suppression." He was instrumental in the calling of the first convention for the consideration of a national horticultural quarantine law. It was the beginning of the agitation which resulted in the passage of the Federal Horticultural Law in August, 1912, 15 years after that first convention.

Prof. T. J. Burrill, most of whose life was spent as a teacher of botany and phytopathology, taught entomology in his early days in Illinois, and published a paper on the white grub in the *Cultivator and Country Gentleman* for August, 1874. Later he wrote about the pear leaf blister-mite and the Lombardy poplar borer.

Prof. E. W. Claypole was an Englishman by birth, a very cultivated and charming man, who taught at Antioch College in the early seventies, and in 1874 published an article on the spring canker-worm. He published a few other entomological articles in later years, and eventually moved to California. I had the pleasure of meeting him at Pasadena early in the present century, and he died there a little later.

A series of very good reports on injurious insects appeared in the Annual Reports of the Iowa State Horticultural Society between 1874 and 1877. The author was A. W. Hoffmeister. They seem to have had a committee on entomology in the Society in those days, and Professor Bessey, whose work is referred to in a previous paragraph, made the reports of that committee for two years and was succeeded by Doctor Hoffmeister.

H. G. Hubbard, whose first note was published in this year 1874, was then a senior at Harvard who had been working in the Museum of Comparative Zoology. Largely due to the influence of Hagen's teaching and his association with E. A. Schwarz, he became a great student of entomology and did some magnificent work in both pure and

applied science. More will be said about him in subsequent sections, and a special section will be devoted to his remarkable report entitled "Insects Affecting the Orange."

In 1875 appeared the first contribution to economic entomology from the pen of Prof. C. H. Fernald, another man who was destined to have a very marked influence on the growth of this aspect of applied science. Professor Fernald came from an old seafaring family and was a sailor in his youth. He began to collect marine forms. At 21 he entered college to prepare himself for a ship captaincy. And then came the Civil War. He entered the Navy, and spent most of his time during the war on shipboard; carrying books with him, however, so that he completed the reading for his college course. After the war he began teaching science, and among other things undertook an intensive study of zoology, including the collection and study of insects. In 1871 he was made Professor of Natural History in the Maine State College, and insects came more and more to occupy his attention. In 1875 he wrote an article entitled "Destructive Insects—Their Habits and Means of Preventing their Depredations" which was published in the Third Annual Report of the Maine State Pomological Society. From then on, his entomological publications were frequent. In 1886 he was made Professor of Zoology in the Massachusetts Agricultural College, which position he retained until 1910. In 1887 he was made Entomologist of the State Agricultural Experiment Station. He died in February, 1921. His greatest work in economic entomology was in connection with the early years of the fight against the gipsy moth in Massachusetts. He was scientific director of the work from 1889 to 1899. He was a man of great executive ability, of very pleasing address, and made an admirable advocate for funds for the work before the Massachusetts State Legislature. All this time he was also doing more strictly scientific work, and became known as the American authority on the Tortricidae.

Once, during the 1890's, I was riding with him along a Massachusetts road, and he said to me, "I wonder, Howard, whether after I die I shall be known as an economic entomologist or as a systematist." My reply was, "You forget one of your greatest accomplishments; you will go down to future ages as a teacher in the first place." And this is perfectly true; he was a most successful teacher, and some of the best of the economic entomologists who have been working since his teaching days were pupils of him and of his son, Henry T. Fernald, who joined him on the teaching staff of the Massachusetts Agricultural College shortly after he gained his doctorate in philoso-

phy from Johns Hopkins University. Fernald's students are found in many places, doing admirable work and holding positions of importance, and all speak of the good training they had while under him.

In 1876 was published the first contribution to economic entomology by Prof. S. A. Forbes. Forbes was a mature man who had served during the Civil War and who apparently was a born naturalist. His early papers related to the food of birds and fishes, but as early as 1880 he wrote about the maple tree bark-louse. He organized the Illinois Natural History Survey, became Professor of Zoology in the University of Illinois, and succeeded Cyrus Thomas as State Entomologist. His bibliography is very long and very important. He is still living (April, 1928) and is looked upon as the dean of American economic entomologists. His writings have been broad and sound and far-sighted. He is an all-round naturalist and a deep thinker. He was probably the first entomologist in the United States to adopt the word *ecology* and to insist upon the broad applications of studies of that character in a consideration of the insect problems of agriculture. There is probably no American writer on entomological topics who is held in more respect and whose writings are as sound and as broad.

In the same year (1876) was published the first paper by J. Duncan Putnam, a young man of the greatest promise, who died in 1880. His admirable paper entitled "Biological and Other Notes on Coccidae," published in the Proceedings of the Davenport Academy of Natural Sciences, is a remarkable piece of work. Possibly Putnam, had he lived, would not have been attracted to the economic phases of entomology, but he was a born naturalist, keen observer, and a man who would have accomplished a very great deal. In these days, when we consider that all phases of entomological study are really in a way economic, it seems certain that his death was a great loss to the world.

In 1877, Prof. George H. French, a good entomologist, who worked for a time as an assistant to Cyrus Thomas when the latter was State Entomologist of Illinois, published his first paper in the *Prairie Farmer*. It was on the Hessian fly. Subsequently he published a number of shorter articles and wrote important sections for Doctor Thomas' Seventh Report. In addition to these, he published in the Transactions of the Illinois State Horticultural Society for 1877-78 a long article on "Insects Injurious to the Vegetable Garden," treating, however, only of Lepidopterous insects.

Miss Emily A. Smith also began to write in 1877. Her first article was on the insect enemies of shade trees, etc., in a book on that sub-

ject by Dr. J. T. Stewart. She afterwards published seven important articles. The one by which she is probably best remembered is her "Biological and Other Notes on *Pseudococcus aceris*," in the North American Entomologist for 1880. Later she went to Europe to study, married there a Mr. Pigeon, and I believe is now living in Boston.

In 1878 James Fletcher began to write, but we have considered him, under the head of Canada, in another place. In 1879 J. H. Comstock published his first paper, although he had been teaching entomology for five years. In that year also my own first paper of record was published, although I had previously written a few newspaper articles.

In 1878 also appeared the first paper of record, of which the date can be ascertained, that was written by Herbert Osborn; but the Bibliography of Economic Entomology includes four titles written by him and published in the Iowa Homestead, the dates of publication not being mentioned. The entrance of Professor Osborn into the publishing field at this time is very well worth mention, because he became one of the most keen investigators and prolific writers in the field of economic entomology. He later became Professor of Entomology in the Iowa State College and Entomologist of the State Experiment Station; still later, State Entomologist; and in 1898 became Professor of Zoology and Entomology in the Ohio State University, in 1916 becoming Research Professor. In addition to his other admirable work, Professor Osborn will always be remembered as one of the great inspiring teachers of entomology in the United States who trained very many of the men now prominent in active work.

Some of the early magazines contained articles on insects. Harper's Monthly Magazine, for example, from 1856 to 1862 contained occasional articles on insects, most of them by Charlotte Taylor. In Volumes 13 and 18 there were articles on insects and insect life, and also on flies, but the names of the authors were not given. They seem to have been written by some amateur microscopist and were rather well done, although, of course, the drawings were very inaccurate and misleading. Miss Taylor's articles were very well written. The literary style was good and she knew her subject fairly well. The illustrations, however, were extremely amateurish and the nomenclature makes it difficult to recognize some of the species. Three of these articles, namely those entitled "Insects Destructive to Wheat," "Insects Belonging to the Cotton Plant," and "Insects Destructive of Maize," are distinctly economic in their character although of little

practical value. Then there was another one on "The Flea," one on "Spiders," one on "The Silkworm," and one entitled "Unwelcome Guests" which related to household insects.

THADDEUS WILLIAM HARRIS

Doctor Harris was born in Dorchester, Massachusetts, November 12, 1795, and died January 16, 1856. His father was a minister of the Congregational Church, and was Librarian of Harvard College from 1791 to 1793. He wrote "The Natural History of the Bible" which was published in 1820. Young Harris graduated from Harvard in 1815. While there he heard lectures by Prof. W. D. Peck on entomology. He studied medicine, and began practice at Milton, Massachusetts. His entomological interest continued, and he constantly collected. He gave up the practice of medicine in 1831, and was appointed Librarian of Harvard where he remained for the rest of his life. From 1837 to 1842 he lectured on natural history, but the subject was a voluntary one and attendance was not required. He also had a private class in entomology.

In 1831 he prepared a catalog of insects, appended to Hitchcock's Massachusetts Geological Report. At a later period he was appointed by the State as one of the commission for a more thorough geological and botanical survey. In the course of this work he prepared his "Report on Insects Injurious to Vegetation," which was first published in full in 1841, the portion on the beetles having appeared in 1838. He reprinted the work under the name "Treatise" instead of "Report," in 1842, and again, in revised form, in 1852. He was paid \$175 by the State for this work. After his death the work was reprinted by the State in very beautiful form, with wood engravings which themselves marked an epoch in that art. It is largely upon this work that Harris' scientific reputation rests. It will always be considered a classic.

During the last 15 years of his life Harris' health was far from good, although he was rarely confined to the house by illness. He worked against odds, yet his life was far from an unhappy one. He led a pure, simple, and busy life. His unenvious spirit is exemplified in almost every line which he has left behind him. His literary style is simplicity itself. Doctor Harris was not by taste an *economic* entomologist. He was a lover of nature and student of insects because they interested him. He did not know agriculture, apparently, except by occasional reading; and yet, with his careful accounts of the life histories of many injurious insects, he laid a basis for much future work. He was keenly aware of the necessity for better remedies

than had as yet been found, but he was not in a position to do any experimentation except to a very limited degree in his own garden, and he introduced, I think, no new ideas as to remedies. Several times he came close to the question of the encouragement of natural control, but never hinted at it. Rather obvious points as to variations in farm practice apparently never occurred to him, and, although in one place he recommends poison baits, he does not go into it fully; and of course the whole idea of poison sprays was brought out years after his death.

The remedies which he recommended were either borrowed from European writers (probably principally Kollar) or were those which had been suggested by American gardeners or by various writers in the agricultural journals and which were more or less in current use.

I think it worth while here to analyze briefly the remedial suggestions made in the "Treatise on Insects Injurious to Vegetation," in order to display as fully as possible the exact condition of our knowledge of those things at the time when Harris wrote. (New ed. 1862.)

REMEDIAL SUGGESTIONS (HARRIS)

June beetles.—Shake from the tree in daytime (p. 31).

Rose beetles.—Hand picking; protect plants with gauze (p. 38).

Wireworms.—Collect from sliced potatoes (p. 63).

Pea weevil.—Keep seed peas over a year in a tight vessel; also sow late (p. 64).

Coleopterous borers in trees.—Protect the woodpecker (p. 71).

Pine weevil.—Cut off shoot in August and burn it; stick cut branches in the ground in the egg-laying season to trap eggs (p. 73).

Plum curculio.—Jarring; gathering fallen fruit; spray fruit with whitewash and glue (p. 80).

Pear-tree Scolytus.—Pruning (p. 91).

Twig pruners.—Collect and burn fallen twigs (p. 99).

Clytus larvae.—Wire; also whitewashing to deter egg-laying; also heading down the trees and collecting the beetles (p. 102).

Apple-borers.—Clean culture; camphor in plugged holes (p. 109).

Flea-beetles.—Sprinkling with tobacco and red pepper; watering with Glaubers salt and water, tobacco water, infusions of elder leaves, walnut leaves, hops; ground plaster of Paris, charcoal dust, powdered soot; sulphur and Scotch snuff; torches; covering with millinet on frames (p. 125).

Turnip flea-beetle.—Sweeping (p. 131).

Blister beetles.—Shaking into pans (p. 139).

Cockroaches.—Poisoned baits (p. 145).

Mole crickets.—Poisoned baits and pigs (p. 150).

Crickets.—Poisoned baits (p. 151).

Grasshoppers.—Drag sheets (in New Hampshire) (origin of the hopperdozer idea) (p. 189).

Squash bugs.—Early hand picking and forcing the growth of plants by manuring (p. 197).

Plant-bugs.—Sprinkling with strong soapsuds, potash water, decoctions of tobacco and of walnut leaves (p. 202).

Vine leaf-hopper.—Fumigation with tobacco under a movable tent; syringing with whale-oil soap and water (p. 229).

Pear Psylla.—Hand picking; wash off with soapsuds and sulphur (p. 234).

Woolly root-louse of the apple.—Melted resin and fish-oil; cleaning up base of tree and large roots; using potash solution (p. 244).

Aphids.—Solutions of soap or a mixture of soapsuds and tobacco water used warm; also hot water; one-half ounce of carbonate of ammonia to one quart of water (Professor Lindley); lime; fumigating with tobacco and with sulphur (p. 245).

Scale insects.—Two parts of soft soap in eight parts of water, mixed with lime to make a whitewash; two pounds of potash to seven quarts of water; one quart salt to two gallons of water (p. 254).

Papilio osterias in parsley.—Hand picking (p. 266).

Pontia oleracea.—Hand picking and collecting the adults with nets (p. 271).

Peach-tree borer.—Remove the earth around the base of the tree, crush the cocoons and borer, cover the wounded parts with moist clay and surround the trunk with a strip of sheathing paper extending two inches below the level of the soil; place fresh mortar around the root to confine the paper. Do this in the spring or in June (original with Harris) (p. 333).

Hairy caterpillars (woolly bear caterpillar and allies).—Pay children to collect them by the quart (p. 351).

Salt marsh caterpillar.—Mow the marshes early in July, and if possible for several years in succession. Burn over the marshes in March (pp. 354-355).

Fall webworm.—Destroy the webs as soon as they appear by stripping them off and crushing them (p. 359).

White marked tussock moth.—Hand destruction of the eggs in the winter (p. 368).

Tent caterpillar of the orchard.—Hand destruction of eggs in winter and early spring; crushing the nests when they are small, *during the hours when the young caterpillars are inside*; brushing off the larger webs or saturating them, with a mop or sponge on the end of a pole, with refuse soapsuds, strong whitewash, or "cheap oil"; repeat as often as once a week (pp. 374-375).

Cutworms.—Soaking of the grain, before planting, in copperas water; rolling the seed in lime or ashes; mixing salt with the manure; fall plowing of sward lands intended for wheat or corn the following year; collecting the larvae by hand; manuring the soil with sea mud; protect cabbage plants by wrapping a walnut or hickory leaf around the stem; also use paper for this purpose (pp. 448-449).

Cankerworms.—Tree banding with clay mortar, strips of old canvas or strong paper tarred; a collar of boards is smeared with tar; collars of tin plate; a belt of cotton-wool (not effectual); troughs of tin or lead filled with cheap fish-oil, etc.; melted Indian rubber; dusting the leaves when wet with dew with air-slaked lime; one pound of whale-oil soap to seven gallons of water used as a sprinkle with a garden engine; jarring the trees; use of pigs to destroy pupae under the ground (pp. 468-470).

Hop vine caterpillars (Hypena).—Syringing with strong soapsuds, or oil soap two pounds to fourteen or fifteen gallons of water (p. 478).

Leaf-rollers and bud-moths.—Pull off and crush withered clusters of leaves containing caterpillars (p. 482).

Bud caterpillars (Penthina).—One pound oil soap to seven to ten gallons of water. One gallon of "the liquor expressed by tobaccoists from tobacco" with five gallons of water (p. 483).

Pine-shoot Tortrix.—Cut off and burn the injured shoots with their inhabitants (European) (p. 484).

Codling moth.—Gather windfalls. Cloth wound around the tree or hung in the crotches to attract larvae ready to spin. Scrape off the loose and rugged bark. Drive away the moths at egg-laying time by the smoke of weeds burned under the tree (p. 487).

Clothes moths.—Expose garments, furs, feathers, etc., to the air and to the heat of the sun for several hours; then brush, beat, shake, before packing away. Brush over walls and shelves of closets, etc., with spirits of turpentine. Powdered black pepper strewed under the edges of carpets. Sheets of paper sprinkled with spirits of turpentine, camphor in coarse powder, leaves of tobacco, or shavings of Russia leather, placed among clothes when put away for the summer. Put small articles into brown paper bags securely closed; also put in a few tobacco leaves or bits of camphor. Chests of camphor wood, red cedar or Spanish cedar. Cloth linings of carriages, wash or sponge on both sides with a solution of corrosive sublimate of mercury in alcohol strong enough not to leave a white stain on a black feather. Fumigate with tobacco smoke or sulphur. Expose to steam for fifteen minutes. Place the infested garment or substance in an oven heated to about 150° F. (p. 496).

Angoumois grain moth.—Heat for twelve hours at 167° F. Early threshing and winnowing of wheat (European) (pp. 507-508).

Fir sawfly.—Soapsuds. Whale-oil soap solution. Shaking from trees in the early morning onto a sheet (p. 522).

Grape sawfly.—Dusting with air-slaked lime. One pound of hard soap to five or six gallons of soft water (English) (p. 524).

Rose sawfly.—Sprinkling with tobacco water. Dusting lime on the plants when wet with dew. Whale-oil soap two pounds to fifteen gallons of water (Mr. Haggerston's—Boston—remedy); also applicable to plant-lice, red-spider, canker-worm, and rose leaf-hopper (p. 528).

Pear slug.—Ashes or quick lime sifted on the trees from a sieve fashioned at the end of a pole (the late Hon. John Lowell, of Roxbury). Haggerston's whale-oil soap solution will probably be still more effectual (p. 532).

Joint-worms.—Burn stubble; also straw and refuse. Manure and thorough cultivation, promoting rapid and vigorous growth of the plant (p. 561).

Hessian fly.—Selection of varieties. Burning the stubble (p. 585).

Horse flies.—Protect the animals by washing the back with a strong decoction of walnut leaves (p. 603).

Onion maggot.—Sow seed on ground on which a quantity of straw has been previously burned (p. 618).

For the last 25 years of his life, Doctor Harris was Librarian of Harvard College. It does not appear that he traveled, and it seems that personally he was unfamiliar with any type of agriculture except that about Boston. He spent as much time as possible in the woods and fields, and obviously was a close observer. The library of Harvard College was small at the time, and there were many books to

which he had not access. A good insight into his character, methods of work and way of thinking is to be gained, not only from his classic volume, but especially from his collected entomological correspondence which was edited by S. H. Scudder and published as a volume by the Boston Society of Natural History in 1869. From many of his letters one gathers a good idea of his great attention to detail and of his remarkable knowledge of the structure of the insects he studied. His correspondence with the English entomologist Edward Doubleday of the British Museum of Natural History, which started in 1839 after a visit Doubleday had made to the United States and lasted for ten years, is of especial interest.

There is no doubt that his "Treatise on Insects Injurious to Vegetation" helped many farmers and gardeners and that it helped many entomologists. More than that, I feel sure that it made many entomologists. I shall never forget my delight when on Christmas Day, 1871, I was given a copy of the new edition with the wonderful illustrations by Sonrel and Burckhardt. They were the best illustrations of insects that had been published, and nothing that has been issued since is better than some of them.

Harris was a learned scholar, a man of good birth and sound breeding, a lover of nature, and one of the best examples of a high type that New England produced a hundred years or more ago. Quite the most beautiful appreciation of his character and of his work that has been published was done by A. R. Grote in his paper entitled "The Rise of Practical Entomology in America," published in the Twentieth Annual Report of the Entomological Society of Ontario in 1899. It is so beautiful a bit of writing that it deserves a place in literature, and it is so high an appreciation of Harris that it should be read by every entomologist. The Memoir of Harris, by Colonel Thomas Wentworth Higginson, which prefaces Scudder's "Entomological Correspondence of Thaddeus William Harris, M.D." should be read in connection with Grote's charming paper. No one who reads these two papers will ever think of Harris except with admiration, deep respect, and affection.

From Colonel Higginson's account it appears that, while performing the Librarian's duties at Cambridge, Harris formed a private class in entomology which met on one evening in every week; and it appears also that he had apparently expected and hoped to be made full professor of natural history in the College. These hopes, however, were not fulfilled, and Dr. Asa Gray was chosen for the post in 1842. Of course, Gray's claims were very high, and it was necessary, apparently, to appoint a botanist of the highest attainments who should

have charge of the botanical garden. Harris' disappointment was never voiced, and he continued his work in his quiet, efficient way, all the time contributing articles on entomology and horticulture to scientific and agricultural journals. He was an excellent botanist, and this fact helped to make his entomological work broader and sounder. American entomologists of today may well think with pride of the man who was really the founder of applied entomology in this country.¹

TOWNEND GLOVER

(AND HIS BIOGRAPHER, C. R. DODGE)

We are more fortunate in the case of Glover than we are with any of the other leading early American entomologists in that we have very full data concerning his life. For a number of years an excellent writer and good entomologist, Charles Richards Dodge, was associated with him in his work in Washington, grew to know him intimately, listened to his reminiscences on many occasions, and after his death wrote a full and very entertaining account of his life and work, which was published as Bulletin No. 18 of the Division of Entomology (1888).

Glover was the first entomologist of the United States Department of Agriculture. He was born at Rio de Janeiro, Brazil, February 20, 1813. His father and mother were both English, and his father was engaged in business in Brazil at the time of Townend's birth. The mother died while Glover was yet an infant, and he was sent home to England and placed in the charge of relatives at Leeds. Six years later his father died. He had been supposed to be wealthy, but for some reason when the estate was settled it was found to be a modest one.

As a boy, Glover was sent to a private school of high reputation, and began at an early age to make a collection of insects which he prepared and mounted with great skill. But his taste for nature was not a specialized one; he was interested in small animals and birds and plants, and this general interest in nature continued throughout his life. From his early childhood he was singularly apt with his pencil, which he chiefly employed in caricaturing people about him, a propensity which is said to have got him frequently into trouble. Much later in life he continued the caricaturing habit, and while he

¹ An interesting article with the title "The Work and Times of Doctor Harris," by R. P. Dow, may be found in the Bulletin of the Brooklyn Entomological Society, Vol. 8, pp. 106-118, December, 1913.

was a resident of Washington he used his pencil effectively against certain government officials.

After he left school he was apprentice to the proprietors of a woolen-goods warehouse, where he remained until 21 years of age. On reaching this age, he was given his small fortune and went to Munich, Germany, where he began to study fruit and flower painting in oil under Mattenheimer. He remained in Germany two years, and acquired a high degree of proficiency in a somewhat limited range of fruit and flower painting.

Friends or relatives had gone to America, and, attracted by the reports of the beauty of this country, he came to the United States at the end of his two years' study of art. He did not intend to make more than a short visit, but, as it happened, he never went back to England except on two short trips years afterwards. He traveled for four years in the United States, visiting the far south and the southwest, collecting insects, birds, and plants; finally returning to the northeast and settling down at New Rochelle, New York. Here he spent most of his time in fishing and hunting, and apparently for a time led an unproductive life. At Fishkill, New York, however, he met Miss Sarah T. Byrnes, and later married her. He then lived at Fishkill for 10 years, leading the life of a country gentleman and occupying himself with the care of fruit and ornamental trees and of his garden. During this period he met A. J. Downing, the author of "Fruit and Fruit Trees of America," became deeply interested in pomology, and elaborated a system of illustrating American fruits by a series of very wonderful facsimiles. He exhibited a collection of these reproductions at various state fairs, and gained a high reputation as a pomologist. Eventually he was invited to take his models to Washington for exhibition.

He arrived in Washington in the winter of 1853, at a time when a new Bureau of Agriculture was about to be established in the United States Patent Office. He received an appointment as "Expert for collecting statistics and other information on seeds, fruits, and insects in the United States." He held the dual position of Entomologist and Special Agent, and his duties necessitated travel in different parts of the country and particularly through the Southern States. He studied the insects of many crops, especially those affecting cotton and the orange.

With the exception of an interval of two and a half years, when, having resigned his position (in 1859), he went to the Agricultural College of Maryland where he taught entomology, he remained connected with the Bureau (made a Department in 1876) until 1878,

writing nearly everything on the subject of insects that appeared in the Annual Reports and engaging himself in the preparation of a great illustrated work on the insects of the United States.

His published reports contain much valuable information, and Dodge's account of the difficulties under which they were written toward the end explains much about them that has been criticised. For years he was constantly at odds with the Chief Clerk of the Bureau, and when he resigned in 1859 he did it because of his difficulties with that official. I have a note which he wrote that explains this resignation, and, as it has never been published, it is worth printing here:

I have now dissolved partnership with, or rather left the U. S. patent office, and am very glad I have done so, as the reports made in my name and under my signature were mutilated, changed and entirely spoilt by the head of the department, D. J. B., who is a notorious plagiarist & wants to take all the credit he can from other men's brains—nay, the last report was actually cabbaged by him from other authors, & then strung together like a string of onions (Agricultural simile) without any knowledge of the subject he was writing about; & parts of *my* own report were added in notes by *D. J. B.* & under his own *signature*, whilst the report purporting to be mine, was written entirely by him or his clerks. We quarrelled about this & here I am, free & independent again—When I left the office all my drawings, sketches, notes, etchings, plates, & specimens, were demanded by him as the property of the department & I had no materials left to commence another work with; this was done on purpose, as he was exceedingly jealous of the reputation I was gaining, & he intended if possible to ruin me & cause me forever to withdraw from public life. His plan, however, did not succeed, as I fortunately found that my scientific friends clustered round me and afforded me all the assistance in their power, altho' I must confess my loss was very severe; it can be of no use to the public if not arranged by myself, as luckily the work was taken away before I had put numbers to the plates, & he don't know a wasp from a butterfly.

One of Glover's unfortunate hobbies was his belief that a picture of an insect is of far more value than a cabinet specimen of the same species. Insects themselves, he always stated, are eaten by museum pests and are otherwise destroyed, but a picture, barring unlikely accidents, will live forever. Convinced of this, he commenced to figure in color every species he procured, and cared nothing what became of the specimens after he had fixed their likeness on paper. Systematic and descriptive entomology he cared nothing whatever about, and it was his boast that he had never described and named a species. In a peculiar and eccentric manner which was quite characteristic, he published two or three volumes. The plates for these volumes, illustrations and text, he etched upon copper himself, printed them in an edition of fifty copies only, and deposited them in the leading

libraries of the country. The text is simply descriptive of the plates, although it contains certain bibliographical references.

The plates just mentioned were done as part of a scheme that must have originated in his mind at a comparatively early date, which was to illustrate the principal insects of North America and to publish these illustrations. We have said that his life at Fishkill was unproductive, but toward the latter part of that portion of his life he was drawing insects and experimenting with different methods of reproducing these drawings. He finally decided to etch them on copper plates, but before leaving Fishkill he had drawn several plates on stone and had submitted prints to Doctor Harris. Harris liked them, and corresponded with Glover with the idea that he might get him to illustrate books that he was preparing or was intending to prepare. After coming to Washington, he continued the preparation of his copper plates. During the period when he was not engaged by the Federal Government (apparently from 1859 until April, 1863) and was connected with the Maryland Agricultural College, he worked industriously on these plates; and after his return to Washington he continued this work, doing it entirely in unofficial time—that is to say, before nine o'clock in the morning and after three in the afternoon. In fact, we may say that his main entomological effort was devoted to his illustrations. He printed some of them upon a hand press and distributed them to different institutions. Many years afterward and just before his death, the original plates were bought by the United States government for \$7,500, and are now in the possession of the Smithsonian Institution.

During his journeyings, especially throughout the south where he traveled more or less during 12 years, and in a trip he took to the United States of Colombia to bring in a new stock of seed sugar cane for the Louisiana planters, and again a trip that he took to the Paris Exposition in 1865, he gained a very great fund of information about the insects injuring crops, and his reports, printed in the annual Bureau of Agriculture reports, contain very many statements of importance.

Before coming to Washington, I had seen, in the library of Cornell University, a copy of Glover's "Manuscript Notes from My Journal (Diptera)" and had a high idea of his competence as an entomologist; but when I came to Washington, I found that he had made no collections of any value (although there was an exhibit collection prepared by F. G. Sanborn and which had been shown at the Philadelphia Centennial Exposition two years before) and had apparently left no permanent records except in his etchings. So my very

high opinion of him largely vanished, and I thought of him for many years simply as a very eccentric man whose personality and career led support to the popular idea concerning all entomologists. In this estimate, however, I did not do Glover justice. While it is true that his principal interests seem to have been in his insect plates and in his agricultural museum, he did some close and intelligent field study on the insects of the orange and of cotton in the middle of the last century, and his annual reports in the late 1860's and early 1870's contain much interesting information. They were very unattractively printed and not well illustrated, but were excellent records of entomological events, written by a competent pen wielded by a man who was as thoroughly conversant with insects as almost any one of his time. The matter in these records, had it been attractively displayed, would have been quite as interesting as many of the notes published by Walsh and Riley in the *American Entomologist* or as many that appeared later in *Insect Life*.

One cannot help wondering what his contemporaries, Walsh or Fitch or LeBaron, would have accomplished with similar opportunities.

One paragraph that Glover wrote, in 1865, on his return from the Paris Exposition of that year has been forgotten. Possibly it was never noticed, and it has great significance in view of what has happened since. He wrote—

As European insects are liable at any time to be introduced into this country in roots, bark, wood, grasses, and seeds, their nature and habits cannot be too well studied or understood here. It is well known that several of the insects most destructive to our crops are of European origin, and I would suggest that all foreign seeds and plants imported by this department be subjected to a careful investigation, and, if found to be infested by any new or unknown insects, fumigation, or other thoroughly efficacious means of destroying them, should be used before distributing them through the country. One pair of new noxious insects will do more harm than hundreds of the well-known varieties, as the progeny might commit their ravages unsuspected till they multiplied past the possibility of extermination, while known and familiar ones would be watched and guarded against. (Report of the Commissioner of Agriculture, 1865, p. 88.)

One good reason why Glover did not do more for economic entomology is the fact that he had to do so many other things officially. This was pointed out as long ago as 1865 by Walsh in one of his somewhat verbose but most readable articles in *The Practical Entomologist*. After stating that there had at that time been very few entomologists employed by the general government or the State and that even those who had been employed had so many other things to do, he referred especially to Glover and to a statement that the latter published in his report for 1863 to the effect that, aside from ento-

mology, he had to handle the questions of insectivorous birds, specimens of fruits, textile materials (hemp, cotton, flax, etc.), Walsh goes on to say:

This is a good deal like hiring a single cradler to harvest a thousand acres of wheat, and then expecting him, in addition, to cut and fetch in wood, peel and wash the potatoes, and be always on hand ready to wait on the good woman of the house. Can we wonder that, under such circumstances, Mr. Glover's report contains scarcely any original investigations, and is in reality, like many similar papers which appear from time to time in the transactions of different State agricultural societies, little else but a rehash of Harris and Fitch. When he should have been looking after the bugs, he was set to work on the birds; if he attempted an attack upon the army-worm he was called off to unpack a basket of apples; and instead of making war on the chinch-bug, the Hessian fly, and the curculio, his time was taken up with preserving and arranging specimens of hemp, cotton, and flax!! Will our rulers at Washington never learn that it is bad policy to put a square man into a round hole? And that, whether round or square, no one man can fit a hole that is as wide across as the dome of the Capitol.

In 1868 an especial building for the Department of Agriculture was constructed on the Mall, and there was a large central space on the second floor which seemed well adapted to museum purposes: and for the rest of his official career Glover devoted much time to this museum. In fact, it seems to have been his main official occupation.

As the years went on, the subject of economic entomology was becoming more and more important in the minds of the people. Harris' work and Fitch's work had made their mark. The writings of Walsh and later of Riley were becoming well known, and there was dissatisfaction with the inertia of the general government in this direction. Glover had made friends among the older generation of naturalists in Washington, and it was largely through some of these friendships that he was able to hold his place so long. It seems that there was a time when Robert Kennicott suggested that Doctor Fitch be brought to Washington to do for the whole country the type of work he had been doing for the State of New York; but nothing came of the suggestion, and Glover stayed on until 1878, when his health failed very seriously and he was virtually retired, C. V. Riley being appointed to his place. Glover lived five years longer. It must have been soon after he was replaced by Riley that his adopted daughter, Mrs. Hopper, and her husband decided that it was not safe for him to stay in Washington any longer and had him and most of his possessions moved to their home in Baltimore. He lived on unhappily for five years, the bright spot in the period being the purchase of his

plates by the government a few months before he died. His death occurred September 7, 1883.

When I came to Washington in November, 1878, Glover was still on the salary roll of the Department of Agriculture. He lived on Twelfth Street just above F, on the east side of the street, but I do not recollect that he ever came to the Department, and I do not know how long he was paid—probably only for a few months. I did not meet him personally until after Professor Riley resigned in the spring of 1879 and Professor Comstock had come to the Department. But after Comstock came, at Glover's invitation, we paid him an afternoon call. It was a unique experience. His rooms and their contents have been carefully described by Dodge on pages 22 and 23 of his account. They resembled a crowded museum. Glover was then 66 years of age, but appeared to me like a very old and decrepit man. As I recollect him, he was, I should say, five feet six inches in height, rather bent in figure, but fairly well nourished—he might have weighed 155 pounds. He moved about with ease, and took a boyish delight in showing us his curiosities. Moreover, he insisted on our taking a glass of wine and a bit of cake with him. He told us that his eyes had failed him to such an extent that he could hardly continue his work of etching, but that he was busily engaged in listing his figures.

It was probably very soon after this that his adopted daughter and her husband insisted upon moving him and his possessions to Baltimore. Dodge paints a sorrowful picture of Glover's unhappiness in Baltimore and says that he was hurt to the quick by the apparent indifference of his former friends. I had no inkling of this at the time. Had I known of it, it would have given me great pleasure to call on him on the several occasions when I visited Prof. P. R. Uhler at the Peabody Library in Baltimore during the next year or two; and I am sure that Professor Uhler, who was the kindest of men, would have done his best to cheer the old man had he known how he felt. When he died (September, 1883) Professor Riley and I went over from Washington to attend the funeral. We saw no other entomologist there, nor did any of his old friends from Washington attend.

Glover's biographer, Charles Richard Dodge, ranks as an entomologist since he was for some time Mr. Glover's assistant. He began to help him first in 1867. He was the only son of the Honorable J. R. Dodge, for many years the Statistician of the Department. Dodge apparently did not work with Glover consistently, since he graduated from the Sheffield Scientific School of Yale University in the class of

1874. After graduation, however, he returned to Washington and stayed with Glover until Professor Riley came in June, 1878. After that Dodge was placed in charge of the museum of the Department, and later became an expert on fibers, writing extensively on this subject for Department publications. He was a man of literary attainments; wrote at least one novel, and contributed to magazines. In the early days of the magazine known as *Outing* he was for some time its editor. He assisted Glover in his general work and helped him to write his later reports. He was enthusiastic about entomology, but never went very far. Mr. Glover told Professor Comstock and me, when we called on him in 1879, that Dodge was a man of great enthusiasm and planned many important entomological tasks, none of which he completed, and in fact none of which he carried very far. I remember especially that Glover said, with a chuckle, that Dodge among other things planned a monograph of the grasshoppers of the United States, but never went further than to write an imposing title page.

Nevertheless, Dodge founded and was the principal editor of a useful little magazine known as *Field and Forest* which was the organ of the Potomac-Side Naturalists' Club. In this magazine he published, among other things, a number of interesting notes on insects, nearly all of a practical character. The "Bibliography of Economic Entomology" lists thirty-three such articles, most of them in *Field and Forest* but a few in agricultural newspapers and three in the *Canadian Entomologist*. It is of record also that he described *Arctia williamsii*, n. sp. from the Rocky Mountains in 1871; and this species still holds.

Dodge married a New Haven lady, Miss Mira Reab, who was an artist; and after marriage he assumed a distinctly artistic pose. He lived in Washington for many years and later in New Haven.

The Honorable William G. LeDuc was Commissioner of Agriculture at the time Glover retired. The magazine *Field and Forest* was sent out by Dodge from the Department during the first few months of Commissioner LeDuc's régime. It is a very interesting example of the tendency of a certain type of European to misunderstand American and English addresses, and of their inveterate tendency to perpetuate mistakes, that for many years European exchanges for this magazine came to the Department addressed "M. le Duc de Field et Fôret." Once, in 1879, I called Professor Comstock's attention to this, when he was annoyed because certain European periodicals had spelled his name C-o-r-n-s-t-a-l-k! I think he felt better after I told him that such mistakes were common.

ASA FITCH, THE FIRST STATE ENTOMOLOGIST

The first scientific man to receive an official commission for the investigation of injurious insects from a State was Dr. Asa Fitch of New York. During its session of 1853-54, the New York State Legislature made an appropriation of \$1,000 for an examination of insects, especially of those injurious to vegetation, and authorized the appointment of a suitable person to perform the work. The New York State Agricultural Society was charged with the appointment and with the supervision of the appointee. At a meeting of the executive committee of this Society, May 4, 1854, the following resolution was passed:

Resolved, That Asa Fitch, M. D., of Washington County, be appointed to perform the work; that he be furnished with such accommodations as he may desire in the rooms appointed for the laboratory in charge of the Society; and that the President and Mr. Johnson, the Corresponding Secretary, be a committee to prepare instructions for such entomological examinations.

The last clause in this resolution seems rather absurd. That Mr. William Kelly, at that time President of the New York State Agricultural Society, and Mr. B. F. Johnson, its Corresponding Secretary, should be capable of preparing instructions for Doctor Fitch is unbelievable. Nevertheless, the instructions signed by these gentlemen were admirable, and I have not the slightest doubt that Doctor Fitch drew them up himself, with the exception of one sentence which reads, "The committee feel assured that in the selection of Doctor Fitch they have secured a person every way competent to discharge the duties imposed, in a manner creditable to the Society and the State." The confidence of the committee was very well placed, but the quoted sentence could hardly have been written by Doctor Fitch himself.

At that time Doctor Fitch was 44 years old. He had passed his boyhood on a farm, was attracted first to botany and later to zoology, finally concentrating on entomology. He graduated in medicine in 1829, and was admitted to practice a little later. All through his medical studies he continued work on entomology, and his medical practice was followed for seven years only. From 1838 to the time of his appointment as official entomologist, he occupied himself with agriculture in addition to his studies of insects, corresponding with European naturalists and building up a great stock of knowledge.

While not officially designated as State Entomologist of New York, he was always given that title by courtesy, and continued in office until 1871 or 1872 when his Fourteenth Report was published and when his health and his sight began to fail. The reports were pub-

lished in the Transactions of the State Agricultural Society from 1854 to 1870, excepting the years 1859, 1865, and 1868. The first 11 of these reports have been published separately as well as in the Transactions of the Society. In 1873, through an appropriation by the State Legislature, provision was made for the revision and republication of the reports; and the revision was completed by Doctor Fitch. The resolution for printing, however, failed of the concurrence of the Senate, and in some way the manuscript was lost. After his death (1879) his collections and library were sold, but this valuable manuscript was not to be found.

The value of Doctor Fitch's labors was very great. In his 14 reports the great majority of the injurious insects of the State of New York received more or less detailed consideration, and in very many cases the life histories of important species were worked out with great care. The remedial measures suggested by Doctor Fitch were, of course, soon superseded, and the practical value of his reports rests almost entirely upon the life history side. The reports contained very few and rather poor illustrations, but they were admirably composed. They contained no flowery language, but were written in straightforward, plain language, with little unnecessary detail. Harris' work had been republished about the time that Fitch began to write; much of John Curtis' work in England was contemporaneous with his, and the greater part of the economic entomology of that period and for some years later, as it appeared in newspaper and magazine articles, in essays like that of Professor Hind on "The Insects and Diseases Injurious to Wheat Crops," were compiled from the writings of these three men. Of the three, I believe that Fitch was the best field man. He was more of an agriculturist than either of the others, and his work was a little closer and a little more definitely described.

Much has been written about Harris and his charming personality. Comparatively little has been written about Fitch. Harris had the advantage of priority. He had the advantage possibly of a better literary style. He also had the advantage that his work was brought together in a compact whole and published with beautiful illustrations. Riley, coming before the public at a time when Fitch was finishing his work, had that advantage, and, filled with later ideas and a positive genius for illustration work, received infinitely more contemporary fame than did Fitch. And yet, as Fitch's work is studied it is evident that he was quite as sound an entomologist as either his perhaps more famous predecessor or his undoubtedly more famous successor, and there can be no doubt that many of his studies were

as finished and as valuable as anything that Riley ever wrote and were more complete than anything that Harris did.

Fitch's personality must have been very attractive. He was a tall, stout, amiable man, who for the most part lived quietly at home working with insects and preparing his reports and articles. Comstock visited him in the early 1870's, and in an after-dinner speech at the entomologists' dinner at Toronto, December 30, 1921 (*Journal of Economic Entomology*, Vol. 15, p. 32), told briefly of this visit. He said:

I found him a very genial old gentleman. He was, as you know, a practicing physician, and like many country physicians he had an office building out to one side in his yard, a little square building, and in that was a really remarkable entomological library. When I talked with him about methods and how to go to work, he said, "The way to do is to sit down and study an insect." That is what I got from him. But it has always been a blessed memory to have seen that grand old man.

In the fall of 1870, Riley and P. R. Uhler spent a day with Fitch at "Fitch's Point." Riley describes him as a strong and very tall man who had become quite round-shouldered while stooping in the pursuit of his studies, and as having a noticeable contrast in the appearance of his left eye as compared with his right one. He was "genial, enthusiastic, unassuming."

From 1871 to 1879 he lived quietly at home and was unable to prepare any matter for publication. He gave up his correspondence with other scientific workers, and was practically lost to the entomological world. After his death, Sanborn and Lintner visited Salem for the purpose of examining material left behind. Aside from the very large collections, which afterwards found a divided resting place, at Cambridge and at Washington, they record the finding of 148 note-books with full descriptions and remarks about the majority of the New York species. The number of specimens referred to in the note-books reached 55,000.

Fitch was a religious man. Why is it that those old, simple, true naturalists, almost without exception, were men of deep religious feeling? The modern scientific man does not possess this mental characteristic. Fitch and Harris belonged to the type exemplified by dear old Kirby, the Rector of Barham. All three of these men combined with their love of nature the love of nature's God. It is related by Doctor Fitch's daughter that, in the course of evening prayers one night, the good old gentleman was reading to the assembled family his customary chapter from the Bible, when a moth, attracted by the light, dropped on the open page of the Good Book. Here was a

dilemma. The spirit of the naturalist, however, overcame the religious feeling, and in a somewhat shamefaced manner the eminent entomologist reached out for his butterfly net and captured and bottled the specimen before finishing his chapter. Was the act an irreverent one? And does the fact that the moth afterwards proved to belong to a species then new to science justify the interruption of the religious exercises?

DATA CONCERNING FITCH'S NEW YORK REPORTS

The first report covers 176 pages and is devoted entirely to insects infesting fruit trees. It devotes 104 pages to apple insects, 3 to pear insects, 11 to peach insects, 2 to plum, 14 to cherry, 6 to grape, and then, considering nut trees as really fruit trees, gives 11 pages to insects affecting hickory and walnut; then gives 2 pages on a pine Coccid, 6 on the cabbage moth, and 1 on the gooseberry midge. The articles on the apple root-louse and the apple tree borers are very carefully done and are distinctly the result of original observations. He devotes much space to the plant-lice of the apples, also obviously the result of careful personal observations. Here, however, he lets his interest in general entomology get the better of him and devotes several pages to the consideration of the little flies that feed upon honey-dew and which have apparently no connection with the economy of the plant-lice, describing several species of Ortalid, Trypetid and Diopsid flies of no economic importance. Then taking up the lace-wing flies among the natural enemies, he gives very careful detailed observations, devoting 14 or more pages to full descriptions of the different species, the descriptions being arranged in an analytical table. He also devotes much space to a Coniopterygid which he names *Aleuronion westwoodi*.

The report is extremely interesting, but about half of it has little direct economic value. At the same time, he avoids a lot of useless writing about problematical remedies, as the following paragraph indicates.

In the treatment of the apple tree borer, to use a medical term, there are two "indications." The first is to protect the tree from attack; the second to destroy the worm. And as we have simple, direct, and effectual modes for accomplishing both of these purposes, there is no occasion for dwelling upon those which are of doubtful efficacy or inconvenient to be applied.

By his careful study of the insects, he is able to point out the exact means of destroying the borers under the bark and several methods of discouraging egg-laying.

The second report again takes up fruit insects, and considers the Lepidopterous enemies and the rose bug. It also includes a chapter on forest tree insects and a long chapter on the chinch bug; also a beginning of the study of insects injurious to wheat and small grains. This second report covers 148 pages. It contains, as did the first report, only a very few poor and small woodcuts.

Later these first two reports were published independently in a bound volume and issued by an Albany printer, one edition at least containing four lithograph plates.

The third report includes more concise accounts of a large number of insects, classified according to their damage to fruit trees, to forest trees, to meadow grasses, to grain and other field crops, to the kitchen garden, to the flower garden and greenhouse, to domestic animals, and to man himself and his stored property. At least this is the outline he gives in his letter of transmittal. This letter of transmittal is of especial interest in that it points out to what an extraordinary extent insects affect humanity. In view of the efforts that have been made of late years to impress people with this fact, the following sentence from this letter of transmittal is very significant:

Many things which are most interesting and remarkable are brought to my view, in the researches in which I am occupied, and I sometimes think there is no kind of mischief going on in the world of nature around us but that some insect is at the bottom of it.

The fourth report was shorter, and less time was taken in its preparation and in the gathering of data to be included. It considered for the main part insects injurious to evergreen forest trees; and its bulk is devoted to the insects of pine, brief consideration being given to hemlock, spruce, fir, cedar, juniper, and larch. The report covered only 67 pages and was not illustrated.

On the third report, for the first time is printed the statement that the copyright had been secured to the author.

The fifth report considers principally insects infesting deciduous forest trees, and the bulk is devoted to oak insects, some consideration being also given to locust, elm, poplar, and birch. This report covers 74 pages, with a few simple woodcut illustrations showing insect work.

In the sixth report (published in 1861) Fitch takes up what is perhaps his most important work, which is on insects affecting growing grains. At that time the wheat midge (now no longer considered a serious crop pest in this country) was exciting great alarm in the eastern States, and the first 87 pages of the report are devoted to its consideration. He states that the insect was probably introduced in

unthreshed wheat brought to the port of Quebec and was noted as destructive in the northwestern part of Vermont in 1828. From that time it had spread itself all over the "free States" and Canada as far west as Michigan and Indiana. The remedy recommended was burning the screenings or feeding them to poultry or swine. He described no certain parasites, and suggested the importation of the European parasites since the wheat midge had been known for years in England and had only recently appeared in France; in fact he wrote to Curtis in England on this subject, who advanced the proposition at a meeting of the Entomological Society of London. So far as I know, however, there were no results. Other insects treated in this report are the grain aphid and the army worm.

One sentence in this report is striking. After stating that the wheat midge was at that time causing loss to the State of New York of some millions of dollars annually, it goes on to say, "and this loss will continue until by accident or by the hand of man the parasitic destroyers of this insect become introduced into this country, when it will disappear, in the same manner that its predecessor and compeer in destructiveness, the Hessian fly, has disappeared and has almost ceased to be felt as an evil."

It is true that the Hessian fly ceased to do serious damage in New York a little earlier than that period, and the later enormous ravages of this species which have continued from time to time until the present have been felt in the great wheat-growing regions farther west; only, however, in regions of winter wheat. It is possible that the lessening of winter wheat in New York and the growing of spring wheat instead, brought about this disappearance of the Hessian fly in injurious numbers commented on by Fitch.

But what is the explanation of the subsequent disappearance of the wheat midge, which in Fitch's time was so enormously destructive? Was there a change in cropping methods? Was there a general adoption of some resistant variety of wheat? Or did the insect parasites of native Cecidomyiids take to the wheat midge and control it eventually almost to the point of extermination? These are interesting questions which it will be very well to make an effort to solve in view of other things that have happened since.¹

This sixth report is prefaced by two lithographed plates, one devoted to the midge and the other to the Angoumois grain moth, the grain aphid and two species of parasites. The drawings were made by Doctor Fitch and are very good.

¹ Doctor Felt has the opinion that the so-called "Wheat Midge" of this country is not specifically identical with the old *Diplosis tritici* of Europe.

The seventh report is prefaced by a lithographed plate of the Hessian fly. It continues the consideration of insects affecting grain crops, and is much shorter than the sixth report. The sixth covered 126 pages, and the seventh only 44. This seventh report contains an account of the Angoumois moth, but is devoted principally to the Hessian fly and to joint-worms. It also contains a little account of the European grain sawflies and a supplementary notice of the wheat midge.

The following year (1862) proved to be very extraordinary from the almost total absence of injurious insects. Fitch wrote in his letter of transmittal that he "was not a little disconcerted to discover a total want of any interesting materials in the fields, the orchards and the forests" on which to bestow his attention. All he could find were the excrescences or galls upon the oaks or other trees and shrubs. The season was noted, however, by one striking thing, and that was the appearance of the asparagus beetle on Long Island. As a result this eighth report contained an account of this insect and several so-called garden fleas (*Smynturus*). He added an account of the vaporier moth, with a description of its egg-parasite, and of a new rose beetle. He appended to this report an historical notice of the first starting of the Hessian fly in this country, and also an account of earthworms.

Of course, it is difficult at this time to explain the absence of injurious insects complained of by Fitch in this 1862 report. My colleague, Mr. J. A. Hyslop, has looked up the temperature and precipitation records, and tells me that the winter of 1861 was dry, with but little snow cover, up to January, which month was much wetter than normal; that from February to June the temperature and precipitation were below normal, but not exceptionally so, and the only decided deviations were the very wet January, the very dry May and the exceptionally wet June; the spring as a whole was cool and delayed.

In the ninth report he again considers insects infesting gardens, and opens with a long account of the tobacco horn-worm and its parasites. In this report for the first time appears the Colorado potato beetle which at that time had not reached New York State but was expected. He devotes a page to the garden tiger moth, and concludes with an account of cutworms and of the "Nebraska bee-killer," a robber fly which he names *Trupanea apivora*. The ninth report covers 48 pages.

The tenth report continues the consideration of garden insects. It treats of the cucumber beetle, the three-lined potato beetle, the hop aphid, the barberry aphid, and the flattened centipede which he

considers to be the probable cause of club-root in cabbages. This report is very short, covering only 29 pages, and is illustrated with three small woodcuts.

The eleventh report takes up the onion fly, the cabbage fly, the striped flea-beetle, the cabbage aphis, the radish fly and worm, the hairy flea-beetle and wireworms, the bulk of the report being filled with a consideration of the last named insects. The report is again short, and occupies about 55 pages.

The twelfth report is 45 pages long, and treats of the buffalo tree-hopper, the yellow-lined tree-hopper, the flowery primrose moth, the Ohio currant sawfly, the currant-worm, the bulk of the report being devoted to the last named insect. This again being an imported species, he hints at the advisability of introducing its natural enemies.

The thirteenth report, published in 1870, is 70 pages in length, and carefully considers the bean aphis, the black-lined plant-bug, the lilac measure-worm, the imported cabbage butterfly, and the native cabbage butterfly, principal attention being given to the newly imported insect.

The fourteenth report (1871) is very short, covering only 26 pages. It considers the scallop-shell moth whose larva eats the leaves of cherry trees, the raspberry beetle, the lettuce earth-louse, the wood tick and certain other ticks, and the "toothache mite"; also the earwig fly.

BENJAMIN DANN WALSH

One of the best articles (the authorship of which is certain) that Riley ever wrote was his "In Memoriam" of Walsh, published as the leading article of *The American Entomologist*, Volume 2, No. 3, January, 1870. Walsh was a very talented and forceful man, and the importance of his work concerning American economic entomology, although it lasted only 11 years and did not begin until he was 50 years of age, was really epoch-making. It has been said often that modern American economic entomology began with C. V. Riley, but after Walsh's work is carefully considered we cannot fail to acknowledge that it began with him. He had a keen, analytical mind, a very broad knowledge of biology in general, was one of the most entertaining and forceful writers who ever handled a pen, and was a man of much culture.

He was born in England in 1808; went to Cambridge University, where he knew and worked with Charles Darwin. He was a classical student of high attainments, and wrote a metrical translation of the comedies of Aristophanes, of which one volume only was published.

He came to America at the age of 30, and settled in Illinois where he farmed for 13 years, afterwards moving to Rock Island where he carried on a successful lumber business for seven years more. He then retired and devoted the rest of his life to entomology. He wrote many articles for the agricultural newspapers, and at the same time published a number of admirable papers in the Proceedings of the Boston Society of Natural History and the Transactions of the American Entomological Society. These papers were of a very high class scientifically. They were especially marked by scientific men both in America and in Europe.

But it is as an economic entomologist that we must consider him; and in this relation we must devote some lines to a little magazine which was started by the American Entomological Society in Philadelphia, called *The Practical Entomologist*.

This journal seems to have been ignored by modern entomologists, but its influence was very great. At first it was distributed gratis, 8,000 copies of each number being sent out. Later a subscription price of 50 cents annually was charged. At the end of two years its publication was abandoned. The editors first chosen were A. R. Grote, E. T. Cresson, and J. W. McAllister, and Walsh was added to this staff after the publication of the first numbers. All through the succeeding numbers appear articles written by him. His ability as an incisive writer, his breadth of knowledge, and his power to prophesy accurately the future of economic entomology were extraordinary. Again and again he pointed out what the States and the general Government should do against the certainty that insect ravages would increase. He appreciated the fact that American farmers were planting their crops in such a way as to facilitate the multiplication of insects. He argued strenuously for the introduction of the foreign parasites and natural enemies of imported pests, and his witty and vigorous invective against charlatanistic suggestions as to remedies make capital reading today.

All through his longer articles one finds indicated the methods of study adopted by Riley, and there can be no doubt whatever that the latter looked upon Walsh as his mentor and model and that very much of the sound character of his Missouri Reports is due to his association with Walsh.

The entomologist of today who does not occasionally spend an hour or so with *The Practical Entomologist* or with *The American Entomologist* subsequently founded and edited by Walsh and Riley and who is not familiar with Walsh's sole report as Acting State Entomologist of Illinois loses a great deal.

Walsh's bibliography shows 385 titles of individual record, to which must be added nearly 500 more which are accredited to Walsh and Riley. Of these 500 titles, however, the majority are short notes and answers to correspondents in the columns of *The American Entomologist*.

Walsh died on Thanksgiving Day, November 18, 1869, as the result of a railway accident six days earlier.

It seems important that an attempt should be made, not perhaps to analyze the work of this man, important as it was in the annals of American economic entomology, but at least to indicate its breadth and extent.

A number of earlier papers, beginning with 1860, were published in *The Prairie Farmer*, *The Western Rural*, *The Illinois Farmer*, *The St. Louis Valley Farmer*, and the *Journal of the Illinois State Agricultural Society*. They dealt with various injurious insects which were common year by year. His first extensive paper was on the Pseudoneuroptera of Illinois, which included descriptions of over 40 new species and was published in the *Proceedings of the Academy of Natural Sciences in Philadelphia* in 1862. Later in the same year he published in the *Proceedings of the Entomological Society of Philadelphia* a very considerable paper on the genera of Aphididae found in the United States; and early the next year, in the same *Proceedings*, occurs an interesting paper on the dimorphism of *Papilio glaucus* and *P. turnus*, citing a similar case among the Pieridae and an analogous one among the Dytiscidae. An important paper published in the *Proceedings of the Boston Society of Natural History* in 1864 is entitled "On Certain Remarkable or Exceptional Larvae, Coleopterous, Lepidopterous, and Dipterous, with Descriptions of Several New Genera and Species, and of Several Species Injurious to Vegetation." The very next month there was published in the *Proceedings of the Entomological Society of Philadelphia* a very important paper entitled "On Dimorphism in the Hymenopterous Genus *Cynips*, with an Appendix Containing Hints for a New Classification of Cynipidae and a List of Cynipidae including Several New Species Inhabiting the Oak Galls of Illinois." This paper is especially notable because it brings up the point of possible alternation of generations with the Cynipidae, an idea subsequently elaborated with great *kudos* by Adler of Germany.

Although Walsh at first was not enthusiastic in his support of Darwin, in 1864 he came quite to his side and in a long paper entitled "On Certain Entomological Speculations of the New England School of Naturalists," published in the *Proceedings of the Entomological*

Society of Philadelphia in 1864, he attacked Agassiz and Dana in opposition to their views. The same year, in the same Proceedings, he published a very suggestive paper entitled "On Phytophagic Varieties and Phytophagic Species."

The very first article in the just-founded Practical Entomologist is one of great historic interest. It is entitled "The New Potato Bug and Its Natural History," and, as stated above, from that time on until its finale the Practical Entomologist contained article after article that may be read to great advantage today.

In the Proceedings of the Philadelphia Entomological Society in 1865 was published an important paper entitled "On Phytophagic Varieties and Phytophagic Species, with Remarks on the Unity of Coloration in Insects," in which he argued for the origin of races and species by phytophagic isolation. In 1866, in the Practical Entomologist of September 29, he listed European insects imported into America and American insects imported into Europe, and discussed the reasons for the increase in abundance of noxious European insects in America, giving his reasons why American species do not flourish in Europe. His last papers of importance were concerned with Hymenoptera, and were broad and sound and important.

His report as Acting Entomologist of Illinois published in the Transactions of the Illinois State Horticultural Society for 1867 is lengthy, covering 103 pages and containing 14 chapters upon different insects of importance. We do not do things nowadays the way he did, but it would be better for some of us if we would study this particular report. Few people can write the way Walsh wrote, and he had a way of stressing important points that was masterly.

CHARLES VALENTINE RILEY

Professor Riley was born at Chelsea, London, September 18, 1843, and died at Washington, September 19, 1895. As a boy he went to school at Bayswater and Chelsea in England, and to boarding school in Dieppe in France, and for a year at Bonn in Germany. He was a lover of nature; collected insects from an early age, and had a passion for sketching them. His cleverness with his pencil was so great that one of his teachers urged him to become an artist.

A sudden crisis in the finances of his family induced him, as a boy of 17, to come to the United States. He went to Illinois and was employed on the farm of Mr. George H. Edwards, about 50 miles from Chicago. He was much interested in the insects on the farm, nearly all of which were new to him, and he watched their

habits, sketched them in their different stages, and began to write letters to the well known agricultural journal, *The Prairie Farmer*, as early as May, 1863. In August of that year, the Colorado potato beetle having reached Illinois, he wrote a description of its eggs and figured and described the larvae for the first time, publishing his article in *The Prairie Farmer*. At the age of 21 he moved to Chicago and became connected with the paper, first as a reporter and delineator, later as editor of the entomological department. During this time he got into correspondence with Walsh and ultimately became intimately associated with him.

His work was interrupted for a brief period in May, 1864, by his enlistment as a private in the 134th Illinois Volunteer Regiment, in which he served until it disbanded in November of the same year.

In 1868, when he was 25 years old, the State of Missouri established the position of State Entomologist, and, on Walsh's recommendation, Riley received the appointment. He held this position for nine years and published a series of annual reports which in many ways were far ahead of anything of the sort that had been done in this country. His illustrations were much better than any that had been printed before; the accounts of the different insects were based upon careful study; the type was large and the print good, and both the farmers and the entomologists were treated to a kind of document that, taken all in all, was unequaled. The previously published reports by Glover, Fitch, and Walsh, with their small type and inferior illustrations, suffered greatly in comparison, not so much in subject matter as in readability and attractiveness.¹

From 1874 to 1876 certain of the western States suffered greatly from an invasion of the so-called Colorado grasshopper, or Rocky Mountain locust, and this subject received careful treatment in Riley's later reports. Moreover, during his Missouri residence the outbreak of the grapevine *Phylloxera* in Europe attracted his serious attention, and he made important studies on this insect in the United States which eventually resulted in the importation of the

¹ Among some old papers, I have found recently Riley's memoranda of the expense of making all of the illustrations in his Third, Fourth, Fifth, Sixth and Seventh Missouri Reports. A charge is entered against each illustration for the cost of the wood-block, for the drawing on the wood, for the engraving and for the electrotpe. The total cost of the 296 figures in these five reports was \$3,738.00, an average of \$12.50 per figure. Considering the very high character of many of these illustrations, this amount seems absurdly small. Eighteen dollars seems to be the limit for the engraving of a single figure, and the artist who drew the figure on the block was allowed one-third as much as the engraver.

American vine into Europe as a root stock upon which to graft the susceptible *Vitis vinifera* and brought about largely the solution of the Phylloxera problem.

The outbreak of the Rocky Mountain locust, threatening as it did a number of the important grain-growing States, induced him to make a serious effort to bring about national legislation, and he eventually succeeded in persuading Congress to appropriate a sum of money and to establish what was known as the United States Entomological Commission, of which he was made chief, the other members being A. S. Packard, Jr., and Cyrus Thomas.

Aside from the appointment of an entomologist (Glover) in the then insignificant Department of Agriculture at Washington, this was the first Federal action that recognized in any broad way the national importance of economic entomology; and the credit for this belongs surely to Riley.

In June, 1878, he had become such a well known national figure in entomology that he succeeded Townsend Glover as Entomologist to the United States Department of Agriculture, Glover's health having failed. He remained in this post until March, 1879, when he resigned and was succeeded for two years by Prof. J. H. Comstock of Cornell. At the end of two years, Comstock returned to Cornell University and Riley was reappointed Entomologist to the Department. In the intervening years he had remained chief of the United States Entomological Commission, with offices at his private residence in Washington. He remained as Chief of the Division of Entomology until June, 1894, when he resigned. He died the following year as the result of a bicycle accident.

Riley's work in the Department of Agriculture bore out his early promise. He published many admirable reports and bulletins and accomplished many excellent things. At the time of his retirement he was probably the best known and surely one of the most highly considered of the economic entomologists of the world.

In looking over the whole field of Riley's life, he appears to me as a very remarkable character, and I have made a rather careful study of it from the beginning, since I was associated with him for many years. I have not mentioned the fact that in 1868 he started, in cooperation with Walsh, an entomological journal called *The American Entomologist*. Walsh died before the second volume was published. Of late I have been reading through these two volumes, and I believe that few people have estimated the extraordinary influence that Walsh must have had over Riley in those early days. Remember that Riley had no university training but that he had a

genius for illustration and undoubtedly a genius for observation and study. It was an enormous advantage for him to be associated with Walsh, and it is to his credit that he took advantage of this association, that he admired Walsh excessively, and that he adopted, in so far as he could, his ideas and his way of thinking, and also, to a certain extent, his way of writing. In those days he must have been a tremendous worker, and he must have been filled with enthusiasm. If my mere statement fails to convince, a reading of either one of the two volumes of *The American Entomologist* will support me fully.

One does not wonder at the impression Walsh made on Riley. Contrast the education and the temperaments of the two men, and their relative ages. Walsh was a man of the highest education that England could give him; he had a keen mind, and was a master of style. He had a sense of humor denied (according to American tradition) to most Englishmen. It is no wonder that the young, impressionable Riley should have formed one of those great enthusiasms of youth for such a character, and it is perhaps no wonder that the inspiration of this collaboration went a long way to make him the strong entomologist that he undoubtedly was.

Judged by his work alone, Riley was a great man, and I think that the small world of applied entomology acknowledges this as it should.

I think that Riley's chief achievements may be summarized as follows:

(1) His Missouri Reports were quite different from anything of the kind that had been published before. They were sound, based for the most part on study and observation; they were illustrated by the most admirable woodcuts of insects that had ever been published in this country,¹ and they were printed in larger type with more attention to form than any previous entomological reports. These reports alone gave him great prominence.

(2) He was largely responsible for the founding of the United States Entomological Commission, and thus for the first broad national investigation of several insect plagues.

(3) He was the first entomologist of the United States Department of Agriculture to start the Federal organization that has grown to such great size and that has done so much important work.

(4) His investigations in connection with the grapevine *Phylloxera* were of the utmost assistance to Europe and helped greatly to bring about the control of this dangerous pest.

¹ They were drawn on the wood by Riley himself.

(5) He conceived and directed the first great and successful international experiment in natural control—that of bringing the Australian ladybird (*Novius cardinalis*) to this country, which resulted in the strikingly rapid control of the white scale, thus saving the citrus industry of California.

These were his five greatest achievements, but in many directions his influence was felt pronouncedly in the development of economic entomology. And his work in a number of fields not seemingly directly connected with applied work was of much importance, as for example in his studies of the fertilization of *Yucca* by the yucca-moths, and that on the hypermetamorphoses of the blister beetles.

JOHN HENRY COMSTOCK

Professor Comstock was born at Janesville, Wisconsin, February 24, 1849. He was a young sailor on the Great Lakes at the time when Cornell University was founded. He has told the story of his early interest in flowers and insects and of his going to Cornell University when he heard of the institution as one that would give a chance for a boy to work his way, supporting himself while getting his education, and as one where everything was taught. He entered the university in 1871 and graduated in 1874. He took natural history work, and was made an instructor in invertebrate zoology immediately on graduation; in fact, he taught entomology before he graduated. I remember that I once heard David Starr Jordan (of the class of 1872) say that he took entomology under Comstock at a time when Comstock was two classes behind him.

Soon after he took his Washington post, Riley employed Comstock as a temporary field agent of the United States Department of Agriculture during the summer of 1878, to study the cotton caterpillar in the South; and when Riley resigned his position as Entomologist of the United States Department of Agriculture in March or April, 1879, Comstock was appointed to succeed him. An account of this in full will be found in a later chapter.

Riley retired to his house at the northwest corner of Thirteenth and R Streets in Washington, taking E. A. Schwarz with him, and there conducted the work of the United States Entomological Commission for the two following years.

In the meantime Comstock worked steadily away at the Department of Agriculture. In addition to the writer, he had to assist him Theodor Pergande who had been with Riley, Mrs. Comstock who did some drawing and some clerical work, and, during the first

summer, he employed William Trelease to conduct certain investigations connected with cotton insects, mostly in the field.

During the first year Comstock prepared his well known Report on Cotton Insects, published as an independent volume by the Department of Agriculture. In that winter he went to Florida and became interested in the insect enemies of Citrus trees, especially scale insects; and then began his work on this important group which culminated in his Report for the year 1880 in which he published a monographic treatment of the scale insects of the United States, basing his classification upon that recently published by Signoret of Paris. This scale insect paper of Comstock's remained standard for a long time, and started the investigation of this group that speedily became world-wide. His two reports, aside from the scale insect paper, were of a character similar to those of Riley and were sound and suggestive, containing a great deal of material of biological importance and also containing numerous practical suggestions.

At the time when Comstock came to Washington he thought that he was threatened with tuberculosis. At all events he was very nervous and in poor health. Occasionally after coughing, his handkerchief would be stained with blood. His salary was small (only two thousand dollars), and his wife drew a salary of twelve hundred dollars. They were building a small house in Ithaca, and sent home as much money as possible to meet necessary payments. The Comstocks, Trelease, and I lived on the most intimate terms. As pay day would approach I would usually have to pawn my watch in order to buy theatre tickets for the four of us. But we spent little time in such amusements. We were all young (it is surprising now to think how young we were!). Trelease and I were 22, Mrs. Comstock was 25, and Comstock was only 30. We were filled with the enthusiasm of youth, worked hard and were delighted with the interesting and important discoveries we made.

Professor Comstock seemed to take it for granted that the policy adopted by Riley in the matter of credits was the proper one. In fact, it was rather generally understood at that time that the chief had the right to sign articles written by his assistants. I thought nothing of it then, but of late years I have been wondering that such an unfortunate policy should have held among scientific men.

Comstock was a very fair and very honest man, as his subsequent career has shown.

With the change of administration in March, 1881, the newly appointed Commissioner of Agriculture, George B. Loring, was overwhelmed with petitions from all sorts of organizations to rein-

state Riley. He was unable to resist the pressure, and Comstock was retired to his old university position, but received from the Department of Agriculture a salary of one thousand dollars a year for one year during which time he was instructed to work at Ithaca upon an addition to his studies of the Coccidae.

Since that time Comstock has remained at Cornell, except for occasional annual journeys during the first few years after the founding of Stanford University, to give courses of lectures out there. He taught actively at Cornell until his retirement in 1914. Since then he has worked on his books and has traveled rather extensively, visiting Europe and Hawaii and other places. His work after he left Washington was not devoted especially to economic entomology. He achieved a reputation as a great teacher, surrounded himself with a number of excellent young men, and did important work in insect morphology. His "Manual for the Study of Insects," published in collaboration with Mrs. Comstock, was a standard book for many years. In 1925 it was succeeded by his "Introduction to Entomology" which bids fair to remain standard for as many more. In the meantime he has published several good books—one entitled "Insect Life," another "How to Know the Butterflies," and still another and much more important one, "The Spider Book."

In the latter part of 1926 he had a paralytic stroke, and has since that time remained almost entirely motionless in bed. His voluntary motor faculties have remained functionless, but the vital processes have seemed unimpaired, and he remains, during his waking hours, apparently perfectly conscious and with an actively working mind. I saw him in the summer of 1928, and he seemed, to look at him, in better health than I had ever known him—not at all emaciated; on the contrary, with a healthy plumpness. He is still living at the date of this writing (January, 1930).

Not long after returning to Cornell, Comstock found a very intelligent young man among his advanced students, and to him he gradually turned over all the work in economic entomology. This young man was M. V. Slingerland who made in his short life a great impression on American economic entomology and who would have done very much more had he lived. He died, however, in 1909. He worked out anew the life histories of some well known insects with remarkable results and his pioneering work in the use of photography in illustrating injurious insects was very effective.

A few years later, Vernon L. Kellogg, who had graduated at the University of Kansas in 1889, went to Cornell to take postgraduate studies in entomology, and accompanied Comstock on one of his

journeys to Stanford University. He made such a good impression there that he was later appointed Associate Professor and remained at Stanford for many years carrying on important research work and publishing several books of a broad zoological character, some of them in collaboration with David Starr Jordan. It seems a pity that Kellogg, with his great ability, never went into economic entomology. With the outbreak of the World War he was drafted into relief work in Europe by Herbert Hoover, and at the conclusion of the war he was made Permanent Secretary of the National Research Council.

Many well known entomologists have come from Comstock's laboratory aside from Slingerland and Kellogg—W. A. Riley, now of the University of Minnesota, R. N. Chapman of the same institution, Glenn W. Herrick who succeeded Slingerland at Cornell, R. H. Pettit now of the Michigan Agricultural College, E. P. Felt, for many years State Entomologist of New York, and many others. A. L. Quaintance, Associate Chief of the Bureau of Entomology, took summer work there, and so have many sound entomologists now in important entomological positions in different places. The Department of Entomology at Cornell has grown to a commanding position, and directly or indirectly is furnishing the country with many excellent workers.

Comstock was the first real teacher of entomology in the United States who carried his work through to a very successful conclusion. Certain German writers, notably my very good friends Karl Escherich and Walther Horn, have emphasized the fact that he was a student of Hagen who was German born and trained. As a matter of fact, this conveys a rather erroneous impression. It is true that he went, during one of his summer vacations, to Cambridge and had a short course of private instruction talks from Hagen, but on the other hand he went to Yale twice and studied with A. E. Verrill and Sidney I. Smith. Nevertheless, he had a great admiration for German entomology, and in 1888-89 studied at the University of Leipsic.

I think that I was fully justified when, in my address as President of the Fourth International Congress of Entomology held at Ithaca, New York, August 12, 1928, I used the following words: “. . . who shall say that in the future, when the vital importance of insects as affecting the well-being of humanity shall have become fully realized, this spot shall not become in a way a shrine where entomologists will gather in token of their respect to the first great teacher of entomology in America?”

Anna B. Comstock, wife of Professor Comstock, has been a great helpmate. Writing in a charming popular style, she threw herself into the nature-study movement and became identified with this

movement in a very prominent way. She mothered generations of young students who came to her husband's department for study, and gave them an insight into home and social life that made their stay at Cornell very pleasant.

HERMANN AUGUST HAGEN

It would be difficult to overemphasize the authority in entomological matters exercised by Hagen when he came to the United States. In those early days he had around him at Cambridge a group of workers of a distinctly high rank: E. A. Schwarz, who was brought over by him from Germany soon after his own arrival; H. G. Hubbard, who graduated at Harvard in the class of 1873; G. H. Crotch, the Englishman; Baron Osten Sacken, and others.

Hagen, in his "*Bibliotheca Entomologica*," had published in the closing pages a very important analysis of the entomological writings of the world, and among other things had isolated from the mass of titles those which referred to economic entomology; and in doing this he had gained a good knowledge of the economic work that had been published. But he was not an economic entomologist. It is true that he wrote a most interesting account of the medieval trials by the courts of dangerous insects and that he wrote a paper suggesting the practical use of the fungous diseases of insects. But no one took him very seriously in economic entomology in those early days. In fact Herbert Osborn has recorded the fact that he worked one winter with Doctor Hagen and that the main thing Hagen tried to impress upon him was that he should not be an economic entomologist—advice, of course, that he did not follow. On the other hand, J. H. Comstock has stated that when he spent some time in Cambridge alone with Hagen, he was given the first special course on insect morphology given on this side of the Atlantic. Comstock goes on to say: "And it was a wonderful course. Years afterwards when I gave a course of lectures on insect morphology myself I would go back for data to my notes on these lectures." Nowadays, when we realize how much sound fundamental training means to the economic entomologist, the influence of Hagen, through Comstock, must not be forgotten.

He was a tall, stout man, whose English was very bad. It was most difficult to understand him. He visited Washington in the early eighties; and that was the first time I saw him. He would not speak to Schwarz. I never learned why. There must have been some misunderstanding between them before Schwarz left Cambridge with Hubbard.

In the autumn of 1887 I visited Cambridge with my wife in order to do some work in the Museum of Comparative Zoology in connection with my taxonomic studies of the Chalcididae. Hagen was working alone and in the same way that has been described once or twice in print by J. H. Comstock, especially as reported in Karl Escherich's book on applied entomology in the United States. He was a very courteous man, and insisted on showing Mrs. Howard (then a young bride and very pretty) around the Museum while I worked. Mrs. Howard had brought her sewing, and would have been quite content to be left alone; but Hagen insisted, and Mrs. Howard, without the slightest knowledge of any of the things he showed her and totally unable to understand him, found herself in a predicament which needed all of her tact. As she told it to me afterwards, he presently stopped and said, "You do not understand me." "Oh, perfectly," she replied; and was very much taken aback when he remarked, "Vell, vot did I say?"

During this visit Henry Edwards arrived one day with a very large box of Australian insects. He had recently returned from Australia, where he had been acting for some years (he was an actor by profession) and incidentally collecting all sorts of insects. I was immensely impressed by Edwards, tall, handsome, cordial man that he was. As Hagen exclaimed over this or that extraordinary Neuropter, Edwards would say, "You may have it." "*Ach! meiner theurer freund!*" Hagen would say, and would then forcibly embrace him and kiss him on both cheeks. I don't believe Edwards had ever been in Germany, and I think this method of expressing delight was as novel to him as it was to me, and naturally made him very uncomfortable, but he did not show it.

Hagen was very generous, placed everything at my disposal, trusted me perfectly, and helped me all he could. His opinion on many entomological questions was for years the last word in America, and American entomology profited greatly by his coming to America at the instigation of the elder Agassiz.

In 1893, at the age of 76, Hagen died. Of his four hundred odd published entomological papers, 47 have been recorded as distinctly economic. The majority of these were short articles in the strictly entomological journals. He wrote a number of longer or shorter papers on the subject of the possible destruction of injurious insects by the application of the yeast fungus, and at one time started a controversy by an article that he published, entitled "The Hessian Fly Not Imported from Europe" (*Canadian Entomologist*, October, 1880). His claim that the yeast fungus, when sprinkled upon injuri-

ous insects or fed to them, would act as a propagator of disease was, of course, erroneous; and his contention about the Hessian fly, although strenuously and plausibly argued, has not been adopted. He tried to show that the insect was present in this country before the War of the Revolution, that it did not appear in Germany until 1857, and that therefore it was of American origin. The conclusion reached by Packard in 1883 (Third Report of the United States Entomological Commission, page 234), that the insect was probably introduced into this country from southern and southeastern Europe, is the one generally held today.

SOMETHING ABOUT INSECTICIDES

Down to the time of the beginning of the use of arsenical poisons for gnawing insects and diluted kerosene emulsions for sucking insects, the effective insecticides used were limited in number and after all were not especially effective. Decoctions of quassia chips, hellebore, limewater and mixtures of ashes and several other things, together with what seems to be an early use of nicotine fumes and tobacco water for plant lice, comprised about all. The charlatan was present in the old days, and secret nostrums and utterly ineffective things were recommended and sold, and there is no more interesting reading than the fulminations of B. D. Walsh against things of that kind. He had an extraordinary command of language, and poured forth his wrath unstintingly and in wonderful phraseology on charlatanistic claims.

In fact, the advertising of quack remedies went to such an extent that the real entomologists were inclined to frown down the whole idea of chemical insecticides. So strong was this feeling that it was expressed very forcibly in the opening editorial in the first number of *The Practical Entomologist* (October 30, 1865). In view of the enormous use of insecticides of great value at the present time, it is worth while to quote two sentences from this editorial:

The agricultural journals have from year to year, presented through their columns, various recipes, as preventive of the attacks, or destructive to the life, of the "curculio," the "apple-moth," the "squash-bug," etc. The proposed decoctions and washes we are well satisfied, in the majority of instances, are as useless in application as they are ridiculous in composition, and if the work of destroying insects is to be accomplished satisfactorily, we feel confident that it will have to be the result of no chemical preparations, but of simple means, directed by a knowledge of the history and habits of the depredators.

To find that these sentences were written nearly 65 years ago by some good entomologist is especially significant in view of the fact

that even today, when the insecticide industry has assumed enormous proportions, the trained economic entomologist remembers all the time that his main idea must be to find some means of controlling insects that will obviate the use of expensive chemical and mechanical measures such as spraying and dusting.

The advance of the Colorado potato beetle was viewed with the utmost alarm by the potato growers of the East in the early 1860's, and nothing effective against it was proposed until some one—no one knows exactly who—began to use Paris green. Down to that time the vines had been treated with hellebore and with ashes, and the larvae had been jarred off laboriously by hand into pans. On May 28, 1869, George Liddle, Sr., wrote from Fairplay, Wisconsin, to the Editor of the Galena (Illinois) Gazette and stated that if one would take one pound of Paris green and mix with two pounds of flour and sift through a coarse muslin cloth on the potato tops early in the morning when the dew was on, the larvae would drop to the ground by thousands. He further stated that this three pounds of the mixture would answer for an acre of potatoes.

Commenting on this in the July, 1869, number of *The American Entomologist*, the editors recommended this as the most effectual and probably the cheapest remedy. They stated that they had tried Paris green and ashes the previous year (Mr. Liddle had stated that he tried it in 1868) and though it killed most of the larvae it did not seem to affect the beetles. They were inclined to believe that the Paris green used was not a good quality. Experimenting again in 1869, the editors had excellent results.

From this beginning, the use of Paris green spread with the spread of the potato beetle, and remains today the standard remedy against this insect.

It was some time before it was used against another insect. In 1872 Doctor LeBaron suggested spraying fruit trees with Paris green and water against cankerworms. Riley in the same year suggested its use against the cotton caterpillar in the South.

LeBaron's recommendation was adopted to a limited extent in the orchards of Illinois, in 1873. Four years later Cook renewed this advice in Michigan, but guardedly. In spraying an orchard in Niagara County, New York, for the cankerworm in 1878, Edward P. Haynes, under the advice of J. S. Woodward of Lockport, New York, found that the apples on the sprayed part of the orchard were less eaten by codling moths than in the other parts of the orchard. Mr. Woodward reported this fact at the January, 1879, meeting of the West New York Horticultural Society, and was almost hooted. Corroborative

evidence came in 1880 through work by Cook in Michigan, and since that time arsenicals of one kind or another have become a necessary orchard means of controlling the codling moth; and the general use of this arsenical for leaf-eating insects of many kinds has been recommended.

For insects that suck the juices of plants, and therefore need not a stomach poison but a contact poison, the first cheap, easily handled and effective insecticide was discovered when Cook in Michigan in 1877 and 1878 found that kerosene would mix permanently with soap solution and that this emulsion could be diluted. Kerosene oil had been used as an insecticide before this, but it killed the foliage. Hubbard independently made a kerosene-milk emulsion in 1881, and later made a very satisfactory soap emulsion, the formula for which remained standard for many years.

Thus in the seventies and early eighties the two standard insecticides were Paris green (or London purple, another arsenical) for gnawing insects and kerosene-soap emulsion for sucking insects; and these, with Pyrethrum for household insects, remained for many years the *pièces de resistance* of the economic entomologist's stock in trade in the way of insecticides.

Along about this time the efficacy of the Bordeaux mixture was discovered by French phytopathological experts, against mildew, and its use soon became widespread for very many plant diseases. In those days I was rather fond of chaffing Doctor Galloway and my other friends in the Division of Phytopathology by saying that it was an easy matter to handle their correspondence, because all they had to do in reply to every letter received was to give the formula for the Bordeaux mixture. One day Doctor Galloway replied, "If it were not for Paris green and kerosene emulsion, it is difficult to see how you entomologists could write a proper reply to a correspondent." Mentally I had to admit our limitations, but of course I did not tell Doctor Galloway so.

It is not, however, my purpose to write a chapter on insecticides nor in any way to indicate the progress that has been made since those days. The publications of every experiment station in the United States show all these later things.

JOURNALS OR PERIODICALS ON ECONOMIC ENTOMOLOGY

The first journal to be devoted to applied entomology in the United States was *The Practical Entomologist*. In our account of Benjamin D. Walsh we have mentioned this journal at some length, but it is necessary to give it especial consideration under this heading. The

Entomological Society of Philadelphia, founded in 1859 and incorporated in 1862 (name changed to American Entomological Society in 1867) decided in August, 1865, to publish short papers on popular entomology for distribution among farmers and agriculturists. They called the publication *The Practical Entomologist* and intended to defray the expenses by advertisements and by private contributions. The object was to send out information in popular form on insects destructive or beneficial to vegetation in the United States. At the start it was distributed gratuitously, although persons receiving it were asked to pay the postage. However, the demand for copies was soon found to be so great that a subscription price of 50 cents a year was asked. The publication was continued for two years from October, 1865, and in all 260 quarto pages were printed and distributed. It was found that interest in the publication dwindled, and at the end of the second volume the financial draft became so great that it was discontinued. The original editors were E. T. Cresson, A. R. Grote, and J. W. McAllister. With the second number it was announced that B. D. Walsh would take charge of communications from the western States, and on the third number his name was printed as Associate Editor. As a matter of fact, the first article in the first number was an excellent consideration of the Colorado potato beetle, under the title "The New Potato Bug and Its Natural History," by Benj. D. Walsh, M. A., and all through the two volumes occur articles by Walsh which to a large extent account for its very distinctive and admirable character.

I do not know who wrote the first editorial, which is headed "Introductory," but it is in this editorial that the significant sentence occurs which we have already quoted under an earlier heading, to the effect that the eventual control of insects will probably be the result of no chemical preparations but will be based upon knowledge of the history and habits of the insects.

The two volumes abound in sound information. The contributions by Walsh, written in his vigorous style and indicating everywhere his opinion of charlatanistic recipes, lend great readability to the journal even at this date.

The magazine was distributed at first at the rate of 8,000 copies of each number, and it seems incredible, in view of the extremely valuable articles, notes and answers to correspondents which it contained, that it should not have continued to receive the wide-spread support of farmers and fruit-growers at the ridiculously small price of 50 cents a year.

When *The Practical Entomologist* ceased publication, Walsh and Riley were not satisfied to let it drop, and they started in September, 1868, *The American Entomologist*, which, although it contained no suggestion of its economic character in its title, was nevertheless largely devoted to applied entomology. The first number contains on its first page a leading and explanatory editorial which is addressed "To the Agriculturists and Horticulturists of the United States." Whereas *The Practical Entomologist* was not illustrated, *The American Entomologist* contained many illustrations, most of them admirably drawn by Riley. Whether the journal was a financial success I do not know, but it was a very useful journal and not only very sound from the scientific point of view, but very practical. It is true that it contained many articles that did not relate to applied entomology, but its general character was highly economic. Walsh and Riley would not have produced a work which was not of this character.

It was published at St. Louis under Riley's immediate eye.

With Volume 2, the title was changed to *The American Entomologist and Botanist*. Walsh died in November, 1869, and Dr. George Vasey,¹ a well known botanist, was associated with Riley in the editorship.

With the publication of the twelfth number of Volume 2 (December, 1870) the journal was discontinued. The leading editorial in that number stated that its publication was simply suspended for one year. But it seems that it was not possible to start it again.

As has been shown, Riley's work in Missouri ceased when he was appointed Entomologist to the United States Department of Agriculture (succeeding Townsend Glover) in June, 1878. As has also been shown, he resigned this office in March, 1879, and for two years worked in Washington as the Chief of the United States Entomological Commission. During this interval he revived the journal under the title "*The American Entomologist: an Illustrated Magazine of Popular and Practical Entomology.*" One volume was published and was labeled "Volume 3, Second Series Volume 1," and elsewhere as "Vol. 1, New Series." Twelve numbers were published between January and December, 1880. It was published by the Hub Publishing Company, of New York, at a price of \$2.00 a year. I am not sure about the subscription price for the first two volumes, but in the number for December, 1870, occurs the notice that the publishers will furnish the volume complete and nicely bound for \$2.50 per copy.

¹ Afterwards for many years the Botanist of the United States Department of Agriculture.

Volume 3 (Volume 1, New Series) was also well illustrated and contained a large number of interesting and important articles. It quite maintained the standard set by the earlier volumes, although Walsh's sound and often caustic contributions are greatly missed.

At the end of the volume, publication ceased. President Garfield had been elected in November, 1880, and Riley had strong hope of returning to the Department of Agriculture under the new administration, a hope that was fulfilled.

The next economic periodical to make its appearance was official. It was entitled "Insect Life" and was published by the United States Department of Agriculture under the editorship of the Entomologist (Riley) and his assistants. At least that was the statement made on the title page of each of the numbers of the first volume (July, 1888, to June, 1889). Volumes 2, 3, 4, 5, and 6 were published under the joint editorship of C. V. Riley and L. O. Howard, and Volume 7 under the editorship of the present writer. *Insect Life* filled a useful purpose. It offered opportunity for the publication of short articles, notes and extracts from correspondence, usually of timely interest, which could not well have been published elsewhere. As it was issued gratuitously by the government, it was printed in a large edition, and sets are to be found in most of the entomological libraries all over the world. It was well illustrated, most of the figures having been drawn by Miss Lily Sullivan, for many years the very competent artist of the Federal entomological service. Miss Sullivan was a modest, retiring, but very capable little woman, who came to the Department in the early 1880's under Riley and who profited by the instructions of this skilled illustrator and who developed a style of her own. I remember a naive remark which she made one day: "What will there be for me to do when I have drawn all the insects?"

Of course, there were other entomological journals. The Canadian Entomologist, for example, was founded in 1869, and, although it was published in Canada and supported by a grant from the Province of Ontario, very many of its contributors lived in the United States. It has continued consecutively as a monthly magazine, and is now in its 59th volume. The journal named *Psyche* was started in 1874 by the Cambridge (Massachusetts) Entomological Society, and is still being published. A journal known as *The North American Entomologist* was started by A. R. Grote, and lived for the year between July, 1879, and June, 1880. One named *Papilio* was started in 1881 by Henry Edwards, and lived to appear in four volumes, dying in 1884. This journal related entirely to the Lepidoptera. From 1885 to 1890 was published a magazine known as *Entomologica Americana*

under the auspices of the Brooklyn Entomological Society. And in 1890 was begun *Entomological News*, published by the American Entomological Society of Philadelphia, which continues to appear.

In all of these journals will be found articles of a distinct economic bearing, but they were published mainly for the benefit of people interested in insects, their classification and habits.

Of course, much of the important matter in economic entomology today finds a place in the *Journal of Economic Entomology*, the periodical started by the American Association of Economic Entomologists in 1908.

About this time it had become evident that the increasing number of working and publishing entomologists of all kinds in the United States had become so great that a new national organization should be founded and that this organization should issue its own publication which should include the longer papers which could find no place in the journals already existing and which were of so technical a character or which dealt so especially with aspects of entomology other than the economic side that they could find place in neither government nor State bulletins and reports nor in the *Journal of the Association of Economic Entomologists*.

This new organization, founded in 1907, was named the Entomological Society of America. It is unfortunate, perhaps, that the name American Entomological Society had already been adopted by the old Entomological Society of Philadelphia, but, in spite of the similarity of the names, no harmful confusion seems to have arisen. The membership of the new organization was large from the start, and in 1908 it published its first volume of *Annals*, which were issued in quarto parts. The first volume covered 393 pages, with 24 plates. The volume for 1928 (Vol. 20) covered 558 pages, with 25 plates. Forty-three plates, by the way, were published with Volume 18 (1925).

The *Annals* of this Society have preserved a very high character. Many of its contributors have been professional economic entomologists who have used this organ for the publication of results of basic investigations which would unnecessarily encumber the direct accounts of results and of practical conclusions drawn from these results that could be displayed in official bulletins. The *Annals* has also included the work of advanced research students done in the laboratories of the larger universities where the teaching has grown deeper and more basic as time has gone on.

The *Journal of Entomology and Zoology*, now (1929) in its 21st year, published by the Pomona College (California) Department of Zoology, has contained very many important entomological articles.

It was founded in the days of A. J. Cook, when C. F. Baker, E. O. Essig, and D. L. Crawford were working at Pomona College under him and with him. I visited the College in those days, and never have I seen a more active enthusiasm in work or a more energetic company. Doctor Cook himself had removed his long beard and looked and acted like an ambitious youth in his twenties.

The Journal of the New York Entomological Society, now (1929) in its 37th volume, is not economic, and belongs rather to the class of society proceedings, but it has contained very many important articles and is always consulted by the economic workers.

The Florida Entomologist, now in its 13th volume, is also the official organ of a more or less local society (the Florida Entomological Society); but its officers and members are largely interested in economic entomology and many of its articles have had a distinct economic bearing.

The Pan-Pacific Entomologist (now in its fifth volume) is published by the Pacific Coast Entomological Society in cooperation with the California Academy of Sciences. Its papers so far have been mainly technical and largely taxonomic, but a number of admirable papers on topics relating to the biology of insects have been published.

There are other publications of local societies that indicate the broad interest that is being taken in entomology, both pure and applied. The Proceedings of the Entomological Society of Washington (D. C.) have been published since 1884. The Bulletin of the Brooklyn Entomological Society was started in 1878 and continued to be published until 1885. Its publication was then discontinued until 1912, but since that date it has appeared regularly.

THE TEACHING OF ENTOMOLOGY IN THE UNITED STATES

In 1872 the condition of the country in regard to economic entomology was rather primitive. Harris had completed his work (his last paper was published in 1860). Fitch's Fourteenth Report appeared that year. Walsh had just died. A. J. Cook had just begun to write. Riley's Fourth Report, on the insects of Missouri, had just been published. LeBaron's second report, on the insects of Illinois, was published that year. Packard had published his second annual report on the injurious and beneficial insects of Massachusetts. The teaching of economic entomology was about to begin.

Comstock was a sophomore at Cornell University, and a year later began to give lectures before his fellow students as a student assistant to Burt G. Wilder who was Professor of Zoology and Physi-

ology. It is an interesting fact that David Starr Jordan, a senior, attended these lectures by Comstock, a sophomore.

This very early teaching of entomology with especial reference to its economic aspects (almost the earliest in this country) deserves some consideration. Conscious of his own lack of training and of broad knowledge of entomology and agriculture, Comstock, tremendously interested as he was in the subject, naturally wished, not only for his own good but for that of his fellow students, to bring out the importance of work in this direction as strongly as possible, and he arranged with the university authorities to bring the young and able and already famous C. V. Riley to Ithaca for two or three lectures. Riley, I believe, had already given such lectures by invitation at the Kansas State Agricultural College at Manhattan, and when he came to Ithaca he attracted a large audience of students in the different branches of natural history, of the teachers in the agricultural faculty, of some of the neighboring farmers, and of the handful of town boys who were interested in insects.

I was one of the latter, about 14 years old, and I was greatly impressed by Professor Riley's picturesque appearance (he was tall, slender, romantic in appearance, with long wavy hair and a luxuriant moustache, looking much more like an Italian artist than like an American economic entomologist). I was not especially impressed by his lectures, since he was not a good speaker, but was charmed by his wonderful ability to illustrate his lectures with blackboard drawings. His crayon sketches were very clever, and if I remember rightly he had acquired the faculty of drawing with both hands at the same time, a method which I think was brought to America by the elder Agassiz and pushed almost into an art by E. S. Morse, one of his early students.

Packard's *Guide to the Study of Insects* had recently been published, and Packard had a very considerable following among naturalists in his ideas as to the number of Orders and large points in the classification of insects. I remember that Riley took an undue time in expressing his own ideas on such questions, which not only had little interest to his audience but which the older men, especially Professor Wilder, considered to be in very bad taste coming from a mere economic entomologist as opposed to the ideas of a trained student of the Agassiz school. On the whole, the lectures were disappointing except for the admirable way in which they were illustrated, and those of us who attended solely from our interest in what may be called the natural history point of view got very little from them.

Comstock, however, although an inexperienced speaker, made his talks very interesting, since he combined the attractive sides of entomology with the practical side in a rather remarkable way. He was very conscious of the fact that he was not well informed, and he desired to improve himself in every way. To do this in Ithaca was impossible, except by reading. He had already started a good library which, of course, later became very strong. Even in those early days, however, his students were able to consult Réamur, Lyonnet, Westwood and other classic and standard books. In his few spare weeks he went away from Ithaca to try to broaden his field. I remember that he went to Yale, and one of my first impressions of that institution came from a story that he told me, that he tried to get lodging in a certain boarding house and was refused because he was not going to work in the college but in the Sheffield Scientific School. I do not know how long he stayed at New Haven, but he went to Cambridge for a short time and studied with Hagen. One of his favorite stories of Hagen has been retold by Escherich on his book on "*Die angewandte Entomologie in den vereinigten Staaten.*" Every morning, Hagen came into the laboratory, said good morning cordially, took off his coat and hung it on the door, unbuttoned his vest, seated himself at a little table, stuck a large German pipe in his mouth, puffed some clouds of smoke into the air, and said "Gumm now, I vill dell you zome dings vot I know."

Hagen had been brought over to Harvard by Agassiz in 1870 and was probably the earliest regular teacher of entomology only, although Harris years before had given certain lectures to voluntary students while he was Librarian at Harvard. All of the other teachers of entomology had been teachers of general natural history which included all of botany and zoology and usually also geology. Comstock's own title, in fact, was at first Instructor in Invertebrate Zoology and Entomology, although his main attention was always given to entomology.

I have said in the opening paragraph of this section that in 1872 the teaching of economic entomology was about to begin. Strictly speaking, this is true, since the entomology that had been taught previously was not really economic except in a way. W. D. Peck is supposed to have given some lectures at Harvard in the earlier years of the last century, and Harris, while Librarian at Harvard, had a private class in entomology after 1831; and the teachers of natural history (there were very few of them) undoubtedly included insects in their curricula.

In an address which I made at the dedication of the Entomology and Zoology Building of the Massachusetts Agricultural College in November, 1910, I spoke of C. H. Fernald who began to teach entomology at the Maine State College in 1872, of J. H. Comstock who began to teach in 1873, and H. A. Hagen already teaching at Harvard, as practically the pioneers. I pointed out that, while Fernald was Professor of Natural History and had to teach all sorts of things, Comstock was confined to entomology and invertebrate zoology, Hagen being really the first professor of entomology.

The publication of this address in the journal *Science* and in *Entomological News* brought some interesting correspondence, and I found that I had overlooked the fact that in 1867 A. J. Cook was really teaching entomology at the Michigan Agricultural College. The catalogues of that institution for the year 1867-68 show that he was an instructor in mathematics. In 1869 he was made Professor of Zoology and Entomology. But Dr. E. A. Bessey has written me that his father, Prof. C. E. Bessey, took a course in entomology under Professor Cook in 1867, and that during 1867 and 1868 he gave a half-year course of entomology in addition to his mathematics.

Mr. A. B. Seymour wrote me that according to his recollection Prof. T. J. Burrill was teaching entomology at the University of Illinois as early as 1868. I wrote to Professor Burrill, who was then living, and he replied that, upon the organization of the University of Illinois, Major J. W. Powell was elected Professor of Natural History and he was appointed Assistant Professor. It seems that Major Powell never took up his duties at the institution. Burrill had been with Major Powell on his first Rocky Mountain expedition in 1867, and in 1868 geology was taken away from the rest of the natural history subjects, but Burrill taught entomology from 1868 until 1884 when S. A. Forbes joined the faculty. He wrote me under date of December 14, 1910, "I had much too slender preparation for instruction in this department, but we had an enthusiastic succession of students taking the work—not a great number, however. The year was then divided into three terms, and we gave the spring term of ten weeks to it, five days in the week."

Since I began to write this section two interesting papers have been published relating to this general subject, and incidentally they have gone into the matter to a certain extent from the historical point of view. The first is "The Courses in Entomology Offered in American Colleges," by Roger C. Smith, Ph. D., published in the *Kansas State Agricultural College Bulletin* of January 1, 1928. The second is the first of a series of articles by Paul Knight, of the University of

Maryland, entitled "The Development and Present Status of Entomological Courses in American Colleges and Universities" (*Journal of Economic Entomology*, December, 1928, pp. 871-877).

Doctor Smith points out that after C. V. Riley lectured at the Kansas State Agricultural College in the college year 1870-71, Prof. B. F. Mudge lectured on economic entomology in the college year 1871-72.¹ Doctor Smith also calls attention to the fact that Rev. J. G. Morris published in the *Journal of Science and Arts* for 1846 an article entitled "Contribution Toward a History of Entomology in the United States," in which he stated that, in addition to Harris' lectures at Harvard, Professor Adams had lectured at Middlebury and he himself at the Pennsylvania College, Gettysburg. The lectures by Adams and Morris were obviously, of course, not of an economic character. Mr. Knight refers to Townend Glover's professorship of natural history in the Maryland Agricultural College to which we have already referred, but states that his work was largely if not wholly along other lines. Mr. Knight also reminds us that Thomas Say taught at the University of Pennsylvania at a certain time and that he was "Professor of Natural History." He adds, "It is hard to imagine Say occupying the chair of natural history and not teaching insect study."

The founding of the agricultural colleges under the Morrill Act in the late 1860's was of course responsible for the real beginning of the teaching of economic entomology, but there were no positions to be filled by entomologists except those of teachers, and the demand for teachers was very small. The economic entomology that was taught by these early men was intended for the most part to train men to meet insect problems in the practice of agriculture. In other words, this training was given to men who expected to be farmers.

When, however, the so-called Hatch Act creating the State Agricultural Experiment Stations was passed by Congress in 1888 there was an immediate demand for entomological workers at the Experiment Stations. There were not enough trained research men in entomology to meet the demand. The places were filled by men who had been teaching entomology, in a few cases, and by others who had had

¹ In a later paper by Prof. G. A. Dean, entitled "Entomology at the Kansas State Agricultural College" (seen in MS. by the writer), it is shown that since Doctor Smith wrote this paper it was discovered that a course entitled "Insects Injurious to Vegetation" was first given at the Kansas institution in 1866 to 1867 by Prof. B. F. Mudge. He repeated this course until 1870-71, when Doctor Riley gave the lectures, as also in 1871-72. It was then taken up again by Professor Mudge. In 1873 J. S. Whitman taught entomology, and continued for six years, being succeeded by E. A. Popenoe.

little or no training. But the passage of the act created what may be termed the first market for economic entomologists in this country. A certain number of positions were created, and therefore a certain number of men began training to fill these positions and others that might be opened up.

It will be interesting to consider the men who were teaching entomology most successfully in the early 1890's. Perhaps the majority of them had received no especial training in economic entomology. The oldest teachers, C. H. Fernald in Massachusetts, Comstock at Cornell, Cook at the Michigan Agricultural College, and Forbes at the University of Illinois were distinctly self-trained and self-educated in entomology. The same may be said of E. A. Popenoe at the Kansas State Agricultural College, and the same may also be said of Lawrence Bruner at the University of Nebraska and of Otto Lugger at the University of Minnesota, although Lugger had been associated with Riley both in Missouri and later in Washington. The same may also be said of John B. Smith at the New Jersey State College of Agriculture, who had never received any scientific education although he had become an entomologist of note and had made two investigations for Riley—the one on hop insects and the other on cranberry insects. All of these men who have been mentioned so far taught for years and trained good students.

There are five more of these early teachers who should be mentioned. Herbert Osborn, who taught at the Iowa State College of Agriculture and Mechanic Arts from 1879 to 1898, was an entomologist by choice who, to perfect himself, studied at the Museum of Comparative Zoology in Cambridge for two summers and again at the famous Naples Zoological Station for two summers. Osborn did not go to the Ohio State University at Columbus until 1898, but since that time he has built up one of the most prominent departments of entomology and has been eminently successful in sending out finely trained men for posts all over the country.

C. P. Gillette, who was the first appointee in economic entomology at the Colorado State Agricultural College, was a graduate of the Michigan Agricultural College and had therefore been a student of Cook. He has been a very successful teacher and investigator and has trained a number of men who have since achieved prominence.

There came to the University of Louisiana at Baton Rouge in 1889 Prof. H. A. Morgan. He came from Canada, where he had been educated at the Ontario Agricultural College and at the University of Toronto. Realizing his lack of training in entomology, he spent part of the years 1892 and 1898 at Cornell with Comstock, and 1895 at the

Marine Biological Laboratory at Woods Hole, Massachusetts. He also was a strong teacher and a good worker, but evidently was thought to be a man for bigger things than entomology, and eventually became President of the University of Tennessee, which position he still holds.

The first appointee in Kentucky was Harrison Garman, a very well trained man who had studied at Johns Hopkins in 1881 and 1882 and who had been an assistant to Forbes in Illinois from 1883 to 1889.

In West Virginia teaching was done for many years by Dr. A. D. Hopkins, a man of no university training but of broad views and much imagination combined with a strong sense of the practical.

The happenings which will be mentioned on later pages, conspiring as they did in the most extraordinary way to focus attention on the importance of applied entomology, had of course a strong effect on the teaching departments of the agricultural colleges and universities. It would be difficult to trace the growth of these departments as the years have gone by, without a great deal of work, which hardly seems necessary. As it happens, I had occasion in 1910 to make a cursory study of the subject for use in an address given at the dedication of the Entomology and Zoology Building of the Massachusetts Agricultural College. The fact that this great building was erected largely for the Department of Entomology was in itself a great mark of progress. Four years previously the University of California at Berkeley had erected a building exclusively for the Department of Entomology. At Cornell at that time entomology had grown to be a large department occupying spacious quarters with extensive libraries and large collections and a corps of six professors, including Comstock himself. There were also six assistants there, of whom four were in biology, one in insect morphology and one in general entomology. There were 190 students in purely entomological courses. At the University of Illinois there were at that time 85 students in strictly entomological courses, 13 of them being graduate students. The teaching staff consisted of one professor, one assistant professor and two laboratory assistants.

At Nebraska there were that year 160 students in entomology.

Since 1910, of course, there has been an enormous development, but this account cannot be carried further. The demand for practical information in entomology has become intensified; hundreds of positions have been created, and therefore many hundreds of students have taken up the work, and all this has compelled the educational institutions to try to meet the demand.

Added note.—I am adding this note in May, 1929. I had seen little of the actual teaching of entomology for many years, although I had been at Ithaca once or twice during term time and had listened to J. G. Needham and J. Chester Bradley lecturing to large classes of obviously interested students. I had also visited the class rooms in the Kansas State Agricultural College and seen Dr. Roger C. Smith hold the attention of a strong group of apparently very intelligent students. I had also visited the University of California, but not during class time. As a result of this paucity of actual experience, I have been surprised and delighted during the past two months at what I have seen at the Universities of California, Washington, Minnesota, Wisconsin and Illinois. The interest in the subject was so great; the number of students was so large; the departments were so admirably equipped; the teachers were so well prepared and so enthusiastic, as almost to satisfy my hopes. I heard actual lectures and attended class-room work only at Minnesota and Illinois. At Minnesota I heard Prof. W. A. Riley, and at Illinois I heard Metcalf and Hayes. The modern method by which advanced classes are instructed I saw first at the Kansas State Agricultural College in the winter of 1925-26, and last spring with the classes just cited. It is vastly superior to the older methods, and affords a direct contact between the teacher and the students that gives the earnest students advantages that they could never have had before. They are kept on the alert at every moment. Some of the boys used to go to sleep under the old, simple, lecture system. To think of the army of young people being trained in this way at the present time almost satisfies my mind as to the supply of teachers and investigators in the immediate future.

Another note.—Last night (November 22, 1929) I addressed the Association of Teachers of Biology of New York City. More than three hundred were present. There was only a handful of outsiders like Stuart Gager of the Brooklyn Botanical Garden and A. L. Melander of the College of the City of New York. I spoke of the importance of making vastly more of entomology in the teaching of biology in the schools, principally perhaps in the high schools. I have hitherto been thinking largely of university laboratories, and of course they dominate the schools to a large degree. But perhaps after all, if there is a pull from the schools—a strong one—the colleges will begin to open their eyes. Melander, an excellent entomologist, told me that there is no entomology taught in New York City, neither at Columbia, at the New York University nor at the College of the City of New York. He explained this in large part as the result of

the fact that these institutions are in a great and crowded city—the largest in the world—and that no one is interested in agriculture or in things that grow. He pointed out that the Entomological Society of New York is small. However, I think that the Torrey Botanical Club is a large society. Some one said to me that the teachers to whom I was talking trained twelve thousand children. I remembered that once, while I was talking at one of the summer sessions of the Teachers College of New York, Doctor Caldwell told me that there were twelve thousand teachers in attendance at this one summer school. Think of the hundreds of thousands of pupils to be influenced by this group of twelve thousand teachers! And yet, I believe that I was the only entomologist who ever addressed any part of that group at New York.

THE ROCKY MOUNTAIN LOCUST, OR WESTERN GRASSHOPPER,
AND THE UNITED STATES ENTOMOLOGICAL COMMISSION

While very great damage had been done in the United States by the Hessian fly, the wheat midge, the chinch bug, army worms, the plum curculio and other insects, and while the eastward march of the Colorado potato beetle had for a time caused much alarm, nothing attracted the attention of the people in general and of the western farmers in particular to the subject of possible insect damage to such a marked degree as did the extraordinary incursions of the Rocky Mountain locust, or western grasshopper, over the cultivated areas of a number of the western States, including Kansas, Nebraska, Iowa, Texas, Oklahoma, a part of Missouri and other portions of the trans-Mississippi in the years 1874 to 1876.

Migratory grasshoppers had been occasionally reported in that general region for many years, and in 1864 there were swarming flights of these grasshoppers which did much damage and caused considerable alarm. Other flights were noticed in the intervening years between 1864 and 1874, but in the latter year the previous experiences dwindled into insignificance; growing crops in many States were devoured, farms were abandoned, the trend of settlers towards Kansas and neighboring States was stopped, and the direst consequences were predicted. Even the eastern newspapers contained startling accounts of the devastation. Thousands of people were said to be starving. I was a college student at the time and was studying grasshoppers with the aid of the recently published "Synopsis of the Acridiidae," by Cyrus Thomas, and I well remember the excitement that was created even in the little town in central New York, very many hundreds of miles away from the devastated areas.

Professor Riley at that time was the State Entomologist of Missouri, and his Seventh Annual Report, published in 1874, contained many pages devoted to the migratory grasshopper and detailed many original observations he had made on its life history in the neighboring State of Kansas. In the preface to this report he showed that the damage done by the grasshoppers during that year amounted to many millions, and he suggested that in the case of this insect, the chinch bug, the cotton-worm and others which brought about national damage, a national commission should be appointed. He further stated that preliminary steps had been taken by leading scientific men "to memorialize Congress to create such a commission, the members to be chosen by the Council of the National Academy of Science, and approved by the Secretary of the Treasury."

In view of the present standing of the United States Department of Agriculture, the immense sums that are devoted to its support, and the wonderful results it has achieved, the following paragraph from this preface of Riley's, written in 1874, is interesting:

We have, it is true, a Department of Agriculture which, if under intelligent and scientific control, might employ the large sums it now fritters away in the gratuitous distribution of seeds, to better advantage in organizing and sending out such a commission; but the people have lost all hope of getting much good out of that institution as at present organized, or so long as the character of its head and management depends on political whim or fancy.

It does not appear that the National Academy of Sciences was ever consulted by any department of the government in regard to this matter, and, unfortunately, I do not know the names of the men referred to by Riley in his 1874 report as "leading scientific men"; and, although damage by the Rocky Mountain locust continued in 1875, it was not until October, 1876, that, at the invitation of the Governor of Minnesota, a conference of the executives of those States and Territories which had been suffering and of scientific men interested in the subject was held at Omaha, Nebraska. This conference passed 12 resolutions, the most significant one recommending that \$25,000 be appropriated to the United States Geological Survey to pay the salaries and expenses of a commission consisting of three entomologists and two western men, to be appointed by the Chief of the Survey, the duties of the Commission being to carry on an investigation of the locust.

It appears that in the session of the Federal Congress in the winter of 1875-76 two bills were introduced. The first (Senate Bill 158) was introduced in the Senate by Senator Harvey of Kansas, and in the House by Mr. Patterson of Colorado. This bill authorized the

Commissioner of Agriculture to appoint three scientific men to investigate the locusts and to report as to the best means of preventing their ravages. It authorized the Treasurer of the United States to pay the expenses incurred in making the investigation, upon presentation of vouchers approved by the Commissioner of Agriculture. The second bill (Senate 438) was introduced by Senator Ingalls of Kansas. This bill gave the Secretary of the Interior authority to appoint a board of commissioners, on nomination of the National Academy of Sciences, to consist of three entomologists eminent in their profession. It authorized this commission to investigate the Rocky Mountain locust, the chinch bug, the army worm, the cotton-worm, the Hessian fly and other insects injurious to the great staples, corn, wheat, and cotton, and to report once each year to the Secretary of the Interior. This bill provided that the commissioners be appointed for the term of five years, to receive \$5,000 per annum each, and also clerical assistance and expenses not to exceed [sum not mentioned] per annum.

Neither of these bills passed, and the final legislation as adopted March 3, 1876, consisted of a clause in the bill appropriating to the Interior Department which provided for the sum of \$18,000 to be spent under the Director of the Geological Survey by a commission of three men to investigate the Rocky Mountain locust. The original sum asked for was \$25,000, and the original board was to have consisted of five men. The amount was reduced to \$18,000, and the number of members to three.

It is interesting at this time to see that the passage of this bill was not greeted with universal approval. It is really worth while to quote from an editorial published in *The Nation* for March 16, 1876:

The Republicans in the Senate, not to be beaten at investigations, have passed a bill to investigate insects injurious to vegetation—the locust, the chinch bug, the army worm, the Hessian fly and the potato bug. The bill provides for an investigator-in-chief at a salary of four thousand dollars a year, the Herculean labors of the head of the Agricultural Bureau preventing that official from giving the necessary time to it. The act, should it pass the House—which seems doubtful—will be a new application of the great principle of division of labor, for in future the Agricultural Commissioner will scatter the seed broadcast over the land, while the national entomologist will follow closely on his trail and exterminate the various bugs that may attack the ripening grain. We only want now another Commissioner to harvest the crops, and another to see that they get to deep water, and the husbandman will be entirely relieved from grinding toil.

This editorial met the eye of Professor Riley, who replied with a letter, published in *The Nation* of March 30, in which he stated that the editor's satirical remarks, if aimed simply at the bill as it passed the Senate, were perhaps justified, but, if aimed at the idea of national

legislation concerning the investigation of insects, he regretted them. The letter follows with a strong argument and urges the appointment of an entomologist on the recommendation of the National Academy of Sciences.

C. V. Riley was made chairman of the commission, A. S. Packard, Jr., secretary, and Cyrus Thomas, treasurer. The appointments were appropriate. Riley had been studying the locust for three years, had published admirable reports about it in his Seventh, Eighth, and Ninth Missouri Reports, for the years 1874, 1875, and 1876. Thomas had made an especial study of grasshoppers, had been connected with the Geological Survey from 1869 until 1873, and at the time of his appointment was State Entomologist of Illinois. Packard, a well known entomologist, had published reports on the injurious insects of Massachusetts, was the author of the well known "Guide to the Study of Insects," and had done work with the Geological Survey. At that time Riley was 34 years of age, Packard 38, and Thomas 52.

Some space should be given here to the work of the Commission, since it was an important step in the development of economic entomology in the United States. The great fears created by the migratory grasshoppers and the enormous damage which they did had focused popular attention on the subject, and the national recognition given to it by the appointment of a national commission marked an era.

Although the funds were lamentably insufficient, the members of the commission were in their prime and were experienced workers. The appropriations for the commission were renewed for two years only,¹ but, taking advantage of the rather loose condition of the government printing regulations at that time, they were able not only to produce the two volumes relating exclusively to the migratory grasshoppers, but also to publish several bulletins and three additional large reports, the third relating to a variety of insects, the fourth to the cotton-worm and boll-worm, and the fifth to forest insects. The last three reports were issued from the United States Department of Agriculture, and the first two from the Department of the Interior, the fifth report not being published until 1890. There were also seven bulletins. The first two related to the migratory grasshopper, the third to the cotton-worm, the fourth to the Hessian fly, the fifth to the chinch bug. The sixth was entitled "General Index and Supplement to the Nine Reports on the Insects of Missouri." This

¹ Ten thousand dollars in 1878 and a like sum in 1879.

was a very useful volume of 177 pages, published in 1881 (during the interval when Riley was not connected with the Department of Agriculture). I cannot see how he induced the government to print this bulletin, but, like all other entomologists, I am glad that he succeeded, for it is very useful. A seventh bulletin, entitled "Insects Injurious to Forest and Shade Trees," by Doctor Packard, was also published in 1881, and this was afterwards elaborated into the Fifth Report of the Commission, a very large and useful volume.

There can be no doubt that the establishment of the Commission was a very desirable move on the part of the government. The situation in the western States appeared to be critical, and while at the present time it seems likely that the locusts would have disappeared in 1877 had the Commission not been founded, and while it seems improbable that later serious locust incursions would have occurred had the Commission's investigations not been made, its creation was not only a valuable psychological move, since it at once suggested beneficial results with a sound basis of scientific investigation, but was a definite movement which recognized the value of scientific investigation of such problems and was a real encouragement to scientific workers as well as to farmers.

It is difficult now to realize the conditions that existed in these States in the autumn of 1876. While return flights of the locusts towards their permanent breeding grounds in the northwest occurred, the significance of these flights was not realized by the people generally, and business stagnation and agricultural despair were widespread, while actual starvation threatened the inhabitants of large stretches of country. Relief organizations had been formed and large sums of money had been contributed to the relief of the crop-dependent population of several States. The calamity for two seasons had assumed almost national proportions. The loss and the distress were accompanied, as is usual in great calamities, by a rupture of the moral sense on the part of many. There were robberies and lootings but, it is good to say, very few crimes of other character. The attitude of the very religious people was interesting. Sermons were preached urging that the calamity was a dispensation of Providence as a punishment for the sins of the people, and days of fasting and prayer were appointed in the hope that the anger of God might be appeased.

The story is told that the Governor of Missouri, when asked by the church people to set a date for a day of fasting and prayer, consulted with Professor Riley on the subject and was told that the flight of the adult from the infested regions would probably begin the first week in June, 1875. Therefore, the wise governor was said to have

appointed June 3 as the fasting and prayer date. I never knew whether this story was true; but on May 31 Professor Riley gave a lecture before the Academy of Natural Sciences of St. Louis, to which citizens generally were invited. In this lecture he distinctly stated that in the course of the next two weeks the insects would leave the State. As this lecture must have been reported with large headlines in St. Louis newspapers, it was probably not necessary for the Governor to consult Professor Riley personally.

When in the spring of 1877 the Commission was organized, Riley, Packard, and Thomas divided the territory between them, and each started on a journey of investigation. In the course of these journeys they were called upon frequently to speak to agricultural audiences and were able to bring relief to the burdened minds and to restore hope to the agricultural population which had virtually lost hope.

As has been shown elsewhere, Riley was appointed Entomologist to the United States Department of Agriculture in June, 1878. The labors of the Entomological Commission were by no means finished, and indeed the first report had not yet been published. As has also been shown, Riley remained in the Department for nine months only, resigning in March, 1879. Immediately after resigning, he opened offices in his Washington house (northwest corner of Thirteenth and R Streets), took E. A. Schwarz with him, and also employed W. H. Patton. This office remained the headquarters of the Commission during the two years following. The ten-thousand-dollar appropriation for the third year (1879) expired on June 30, 1880.

The Reports published by the Commission are of permanent value. They covered, as has been shown, a rather wide range of subjects in entomology, and contained a number of papers of much value, the authors of which would possibly have had difficulty in placing them elsewhere. The Reports were widely distributed and may be found in numerous scientific libraries in Europe today. They exercised a marked effect upon the esteem in which American economic entomology was beginning to be held around the world.¹

ENTOMOLOGY UNDER THE FEDERAL GOVERNMENT, 1878-1894

We have elsewhere seen how Townsend Glover worked for many years single-handed not only as Entomologist to the Federal Govern-

¹ As an evidence of this: Many years later (I think in 1908) I was introduced personally to Dr. L. Sambon, then of the London School of Tropical Medicine. He acknowledged the introduction with the greatest cordiality, saying: "Of course I know of your great work against the migratory locust." He got the man wrong, but he was right about the work!

ment but as the sole creator of an agricultural museum, from 1855 until 1878, with the exception of a few years during and just after the Civil War when he resided and worked at the Maryland Agricultural College at College Park, Maryland. We have seen how he was assisted during the closing years of his work by Charles Richards Dodge, and that F. G. Sanborn, of Massachusetts, was employed to prepare for the Department of Agriculture an entomological exhibit for the Philadelphia Centennial of 1876. We have also seen that Glover was succeeded in June, 1878, by C. V. Riley.

The summer of 1876 had been one of the years of very great damage to cotton by the leaf caterpillar, *Alabama argillacea*, or, as it was then called, *Aletia argillacea*. Immediately on taking office, Riley had been appealed to by southern planters for an investigation of this insect and he had J. H. Comstock of Cornell University appointed as a field agent and sent him into the field at Selma, Alabama. It also happened to be a yellow-fever year, and Comstock was really in considerable danger in the south, but he stuck to his work and turned in a good report in the autumn. As Professor Riley needed an office assistant, he asked Comstock on his way south whether he had a graduate student at Cornell who would like to take the post, and Comstock recommended the writer who at that time had just finished a year's postgraduate study preparatory to medicine at Cornell University. In the course of time the appointment was made, and I reached Washington November 12, 1878. I stayed overnight with a college friend on F Street near Thirteenth Street, and on the morning of November 13 walked down Thirteenth Street to the old Department of Agriculture Building which at that time stood alone in the great park south of Pennsylvania Avenue. There was a lily pond just inside the entrance to the grounds. The park was well grassed, with undulating surface and with small trees grouped according to their botanical classification. Rows of small ginkgo trees had been planted two years before bordering the main driveway. The ugly, red brick, mansard-roofed building was very much in evidence, and there were greenhouses immediately to the southwest by west, the space occupied by the present West Wing being planted with an orchard of small Siberian apple trees.

I found that the entomological work was being done in two rooms on the second floor of the west end of the building, the large north-western room being filled with floor-cases with flat tops carrying the collection of injurious insects prepared by Sanborn two years before. I entered this room, finding it apparently unoccupied, but after walking around between the cases I found over in the north window a very

short, dark man with a full brown beard, who paid no attention to me but was busy with his microscope. I asked for Professor Riley, and the little man with a strong German accent replied "He vill gum soon" and went on with his work. In a few minutes the door opened and in came Professor Riley, whose office was in the adjoining hall room.

I expected to be put at entomological work at once, but found that I was to be used at first as a clerk. Riley dictated letters to me, which I took down in a bastard shorthand I had invented while taking lecture notes at Cornell. I was initiated into the use of the copy-press, and was used solely as a clerk for several weeks, later being entrusted with the preparation of a manual of silk culture, and later growing into other work of more importance.

Glover seemed to have left no collections. The National Museum was not in existence. There were supposed to be in the Smithsonian Institution some specimens collected during the different surveys of the territories, but I never saw them. Riley had brought on his own collection from Missouri which at that time was contained practically entirely in large book form double boxes and was in fairly good condition since it had received the care of Luggar and later of Pergande. Riley lived on the northwest corner of Thirteenth and R Streets, and at his home (he was recently married) lived his half-sister whom he employed as a clerk but who did not come to the Department. E. A. Schwarz had been employed as a traveling agent, and during this winter was sent to the Bahamas as well as to different portions of the southern States in order to learn if possible something definite as to the winter quarters of the cotton moth.

During the winter George Marx, a man of German birth, in his late thirties, a handsome, genial fellow, was taken on to do some drawing. He had been trained as an apothecary, had served through the Civil War as a hospital attendant, and had been connected with the drug business in Philadelphia with very indifferent success. But he drew well, and was interested in the study of spiders. He occupied the south room with me, the north room being largely filled with the exhibit collection returned from the Centennial Exposition. In the north window of that room was the little German who had greeted me on my arrival. He was Theodor Pergande.

The Riley collection was placed in bookcases in the south room. The Commissioner of Agriculture at that time was the Hon. William G. LeDuc. The Department was very small, housed entirely in the three floors of the mansard-roof building at the foot of Thirteenth Street (torn down in the summer of 1930), and every one in the Department knew all the others. The Commissioner frequently

walked about the building, showing the Department to agricultural friends from Minnesota. This was so soon after the outbreaks of the Colorado grasshopper that these western friends of Commissioner LeDuc's, when he showed them into the entomological rooms, almost invariably asked to see specimens of that particular grasshopper. The Commissioner had learned the position of the book box containing this grasshopper on the shelves in our room, and used to go directly to the box, read the Latin names on the label, open the box and show it to his visitors with the pride of a learned *scientifico*. Marx was something of a practical joker, and one day he altered the position of the boxes, so that the Commissioner was much confused the next time he tried to show the Colorado grasshopper to a friend.

Riley, having largely by his own efforts secured from Congress a law establishing the United States Entomological Commission to investigate the Rocky Mountain locust, or Colorado grasshopper, and having also received an appropriation for its conduct, had gained the idea that he could go directly to Congress on all subjects. Consequently, that winter he called upon some of his acquaintances on Capitol Hill and urged slightly larger appropriations for the entomological work of the Department of Agriculture. The Commissioner thought that that was his job, and hard feelings resulted which became so intense that Riley was allowed to resign in the spring (1879).

He was quite concerned about his possible successor, and wrote at once to the Reverend Cyrus Thomas of Illinois, one of his colleagues on the Entomological Commission, and urged him to apply for the place. Commissioner LeDuc, however, did not wish to appoint any of Riley's colleagues, and wrote himself to Andrew D. White, the President of Cornell University. Doctor White consulted Professor Comstock, who concluded that he would like to try it; and so he was given two years' leave of absence from the University and came to Washington as Riley's successor. This was a very pleasant change for me, and the atmosphere of the office became distinctly more agreeable. Pergande and I stayed on, but Schwarz went with Riley, who opened offices in his house at the corner of Thirteenth and R Streets, where they continued the work of the United States Entomological Commission.

The relations between the two offices were far from harmonious. Riley, of course, took his private collection with him when he left the Department. He was also accused by Comstock of taking a great many specimens which he should have left. During the ensuing two years these men never met except at the meetings of the Biological Society of Washington which was organized as an offshoot of the old

Philosophical Society of Washington in 1880. And this was not often, since Riley was more prominent in the organization than was Comstock, and the first meeting of the Society was held at the former's house.

When Comstock came to Washington his health was poor. He feared tuberculosis of the lungs. After a fit of coughing, I often noticed that his handkerchief, when he removed it from his lips, was blood-stained. During the summer that followed his appointment, he, Pergande and I worked enthusiastically on the different insects that were brought to our attention, with Mrs. Comstock doing clerical work and George Marx preparing illustrations. There resulted from this work a very good report that contained a number of rather important articles, some of which have a decided interest today. I wrote most of the articles in this report, basing many of them on the careful laboratory rearing notes made by Pergande. The article on the clover seed midge in this report seems to me to be especially significant, since, after studying the life history of the insect and after gaining full information as to clover cropping methods, I was able to make one of the earliest recommendations as to a slight variation in cropping methods, the adoption of which rendered this particular insect no longer dangerous in eastern clover fields.

The remedy for the grapevine flea-beetle proposed in this report is also one of my ideas, the beneficial effect of which I proved experimentally. And the rather full articles on the oak leaf-miners I prepared from my own notes and they were at first intended as a thesis for a master's degree at Cornell.

The articles in the report in which Professor Comstock took the greatest personal interest and upon which he personally did the most work were those upon "The Frustrating Retinia" and "The Pitch Pine Retinia," and also the one on "Predaceous Lepidopterous Insects."

Moreover, all through the summer we worked upon a report on cotton insects, a subject in which Professor Comstock was especially interested on account of his engagement the previous summer by Riley to work in the cotton fields of Alabama. This resulted in the publication of the "Report on Cotton Insects" in the late autumn of 1879.¹

¹ In the meantime Riley and his assistants were working on a report on the same subject, which was subsequently published as the Third Report of the United States Entomological Commission. As it happens, I wrote much of each of these reports, among other chapters, those on the natural enemies of the cotton caterpillar. In the interval between the publication of these two reports, I changed my mind about the function of the so-called *Phora alethiae* and had the somewhat

During the winter of 1879-80, fearing the effect of cold weather in Washington, and also seeing the necessity for an investigation of insects affecting Citrus trees in Florida, Comstock went to Florida, and there became interested in the scale insects, an interest which continued for two or more years and resulted in the publication, in his annual report for 1880, of a consideration of the scale insects, published as Part 2 of the report, which was the most thorough and extensive work of this kind that had been published in the English language and which formed a sound basis as well as an incentive for the vigorous investigations of the insects of this group which continued in the United States for many years. The life history studies were very largely made by Pergande.

The preparation of this report had a vivid personal interest to the writer, since appended to it as Part 3 was published a report on the parasites of the Coccidae in the collection of the Department, which was the first paper I was permitted to sign.

As it happened, there was no one in the United States at that time working upon the smaller Chalcidoidea (E. T. Cresson had described many of the larger forms in the genera *Chalcis* and *Smicra*). And so I took up the study of the smaller and neglected forms. Incidentally, in this report I pointed out the ease with which the parasites of Coccidae could be transported from one region where they abounded to regions in which they were absent or scarce. It was one of the earliest of the suggestions of this character.

Having become interested in Citrus insects and especially in scale insects, Professor Comstock went to California in the summer of 1880, and during his absence Prof. C. H. Fernald came to Washington as an agent of the Service to work on certain Tortricids which we had been studying; and Dr. William Trelease also spent the summer with us writing up reports on observations he had made during the previous summer as an agent of the Department, on cotton insects.

In November of that year Garfield was elected President, to take office the following 4th of March. In those days, before the passage of the Civil Service law, a change in the President meant a change in a very great many offices. No one felt sure of holding his position. Personal congressional influence was sought for and relied upon. No one working under the government at the present time

malicious pleasure of presenting in the second report arguments favoring the view that it is simply a scavenger, in opposition to the conclusion in the first report that it is a true parasite, knowing all the while that my name would not be allowed to appear as author of either chapter.

can begin to realize the unrest of those days and how it affected the efficiency of most employees. Nor, indeed, can one today realize how many utterly incompetent persons were given clerkships and other official positions. It must be said, however, that strictly scientific men were rarely discharged. Nevertheless, Comstock, knowing Riley's enmity, feared the event that really occurred; although, with his Cornell professorship to fall back upon, it was not a matter of so great concern to him as it was to me.

About the first of February, 1881, a wealthy traveling Englishman, passing through Washington, accidentally made the acquaintance of Professor Comstock and myself, and told the former that he would like to take me with him as far as New Orleans and possibly further. As it happened, the Department had received requests from Louisiana for information concerning damage by insects to sugar cane. There was no money available, and so the opportunity offered by the Englishman (Mr. T. U. Brocklehurst) was grasped, and I was able to spend the following month investigating the sugar cane root-borer (*Ligyryus rugiceps*) up the Bayou Teche and the cane borer on the old Wilkinson plantation (Magnolia) down the river south of New Orleans. Mr. Brocklehurst wanted me to go on to Mexico with him, but fearing the results of the change of administration, I returned to Washington.

Immediately upon the inauguration of President Garfield, the Hon. George B. Loring of Massachusetts, a former Member of Congress, was appointed Commissioner of Agriculture, and he was at once deluged with letters from all over the country—from individuals, from farmers' organizations, from Masonic organizations, and from Civil War veterans' associations—urging him to reappoint Professor Riley at the head of the entomological service. Commissioner Loring was unable to resist this widespread appeal, and in consequence Riley was appointed Entomologist, and Comstock went back to Cornell with an allowance of one thousand dollars for one year to complete his work upon the scale insects.

Professor Riley brought E. A. Schwarz back with him. Commissioner Loring insisted upon the appointment of Benjamin Pickman Mann, of Cambridge, as an assistant, and he also insisted on the appointment of Miss Mary G. Champney¹ as a clerk. Riley also had appointed Dr. W. S. Barnard, who had occupied Professor Comstock's chair at Cornell during his absence and who had also done some work for the United States Entomological Commission the previous summer on machinery for use against the cotton caterpillar.

¹ Miss Champney remained in the service until 1927, retiring on account of age.

Mann's work was exclusively bibliographical; Barnard's exclusively with machinery. The latter invented the so-called Cyclone Spray Nozzle, afterwards called the Riley Nozzle and, in France, the Vermorel Nozzle. He also invented ingenious machinery for under-spraying the cotton fields with Paris green but which proved to be unusable on account of the uneven quality of the ground.

The useful Pergande was, of course, retained. I was much in doubt about myself, and, I imagine, so was Riley. On resuming office, he sent me at once to Illinois to investigate an outbreak of the army worm, and immediately on my return he sent me to Georgia to investigate rice insects. On my return to Washington, I wrote up my reports, and I imagine that it was the fact that these were well done that induced the chief to retain me in the service.

Then followed 13 years of slow but steady growth and accomplishment. The conditions of work in the entomological organization were not of the pleasantest kind, owing to the personal characteristics of the chief. He was a restless, ambitious man, a great schemer, and striving constantly to make his work appear more important. He was ambitious to build up a large organization. Unfortunately, he made many enemies. Some of these were in the Department of Agriculture itself while others were in Congress. Although his first interest was in promoting the work of the entomological branch of the Department, he was also interested, although in a lesser degree, in the work of the Department as a whole. It must not be forgotten, for example, that he was one of the first to advocate the founding of the Office of Experiment Stations which had for years such a phenomenal growth, and that he was a warm advocate of the appointment of the first Director of that office, Prof. W. O. Atwater. Nor should it be forgotten that (possibly at the suggestion of Elliott Coues and C. Hart Merriam—then a young man recently graduated in medicine but much more interested in birds and animals—but apparently out of his own mind) he advocated and was largely instrumental in bringing about a branch of economic ornithology for the purpose of making a scientific study of the food habits of birds in order to determine among other things their value to the farmer as destroyers of injurious insects. Appropriations for this work were secured, and it was begun at first as a branch of the entomological service which by that time had been officially designated as a "Division" of the Department of Agriculture. The section of economic ornithology developed eventually into the Bureau of Biological Survey and has grown very greatly in scope and importance, spreading out at first into an investigation of the faunal life zones of the United

States, later into game and bird protection, bird refuges, the destruction of wild animals injurious to stock and to agriculture generally, and in other directions.

In the more strictly entomological features of the work, important investigations were made on the chinch bug, the Hessian fly, the codling moth, the plum curculio, the hop aphid, destructive grasshoppers, and a host of other injurious forms. The force at work was at no time large, nor did the appropriations exceed \$30,000 per annum.

Of especial importance during this period were the advances made in the development of new insecticides and of machinery for their distribution. The use of arsenicals in different forms was elaborated; the possibilities of home-grown Pyrethrum were considered on a large experimental scale; kerosene emulsion sprays were invented, and many machines were suggested, perfected and introduced into practice. Moreover the use of hydrocyanic-acid gas as an insecticide was discovered and began to be used in California Citrus culture.

Perhaps the most striking feature of this period was the magnificently successful expedition to Australia for the purpose of finding the natural enemies of the white or fluted scale, an insect which threatened the destruction of the Citrus-growing industry of California. This success led to an intense interest in the subject of natural control and forms the basis for a great amount of beneficial work which has been done since that time.

Many bulletins were published during this period, and in 1888 was started the publication of the periodical bulletin known as *Insect Life* which was carried through seven annual volumes and perhaps did more to stimulate interest in applied entomology than almost any other single agency during this period.

Looking back and noting the admirable work which was done by the Federal service during Riley's incumbency of office, the modern economic entomologist cannot fail to be deeply impressed; and, judging by results, Riley deserves very great credit. Intimately associated with all of this work as I was, for he soon made me his principal assistant, I can find myself admiring some of his qualities very greatly; but at the same time there was during the entire period an amount of dissatisfaction and of unrest and of unfair treatment of subordinates that made the period anything but happy. He quarreled with A. J. Cook over the invention of kerosene emulsion; he quarreled (and quite justly) with the California people over the credit for the introduction of the Australian ladybird; and he quarreled with many other persons and organizations about many different things. It is all past now, but I cannot help thinking that much more would have

resulted if he had encouraged independent work on the part of his associates and if he could have exercised more tact in many ways. It must be said that for a number of years before his accidental death he was in very bad health. He had frequent headaches, and was troubled with insomnia. This accounts for much of his restlessness. He could sleep on a long railway journey, and could not sleep in his bed at home. Moreover, he found that he could sleep in a barber's chair better than he could in his own bed. It seems not to have occurred to him to install a barber's chair in his house, but after a sleepless night he would often go to his barber and pay by the hour for a chance to make up lost sleep. All this must have affected his disposition seriously, and must have accounted for some of his rough angles.

Annual appropriations increased very slowly. Field workers were appointed from time to time to send in reports on field conditions in different regions. A few old personal western friends were given such commissions, like J. G. Barlow of Cadet, Missouri, and Miss Mary E. Murtfeldt of Kirkwood, Missouri, J. G. Neal of Florida, and later Lawrence Bruner of Lincoln, Nebraska, Herbert Osborn of Ames, Iowa, and F. M. Webster, then in Indiana, and still later D. W. Coquillett of Los Angeles, California.

In 1884 Grover Cleveland was elected President of the United States, and in April, 1885, Commissioner Loring (Republican) was succeeded by Hon. Norman J. Colman (Democrat), an old Missouri friend of Professor Riley's, the editor and proprietor of Colman's Rural World of St. Louis, who, toward the close of his administration (February 9, 1888) was made the first Secretary of Agriculture, since at that date the Department was made a true executive department. Secretary Colman had less than a month to serve, however, as the Republicans had gained control in the election of the previous November, and in March, 1889, President Harrison made Hon. J. M. Rusk Secretary.

These seem to be matters of slight importance from the standpoint of entomology, but nevertheless they should be mentioned because with the incoming of Secretary Rusk he had an Assistant Secretary appointed (Hon. Edwin Willits of Michigan) to whom he assigned the supervision of the scientific work of the Department. To Commissioner Colman Professor Riley had had free access at all times, but under the new arrangement he was seldom able to consult the Secretary. He and Mr. Willits, unfriendly from the beginning, became still more estranged, and this official lack of sympathy with his plans, added to his increasing bad health, had a very unfortunate effect upon

Riley and upon his ability to concentrate upon his work. Almost everything was turned over to his principal assistants. He made me coeditor of *Insect Life* and allowed me to attach my name as co-author to several large yearbook articles which I had written. Riley took long journeys to Europe and to the West Indies, and toward the end of the administration became more interested in politics than he had ever been before.

At the autumn elections of 1892 the Democrats came back into power by the reelection of President Cleveland. Riley had been a supporter of Cleveland, and called on him in New York soon after the election. He told me that at that time he urged the President-elect to appoint Hon. Sterling J. Morton of Nebraska (an old friend of Riley's) Secretary of Agriculture, and that he felt that Morton if appointed would make him Assistant Secretary in charge of all scientific work of the Department. When Secretary Morton came to Washington in March, 1889, Riley gave a large reception in his honor at his beautiful house on Washington Heights, and invited all of the prominent men of Washington to meet him. He fixed the time at the annual meeting in Washington of the National Academy of Sciences, so that very many of the most prominent scientific men in America were present. These strenuous attempts to impress the Secretary had the opposite result from that expected. Dr. Charles W. Dabney, a prominent chemist, later President of the University of Tennessee, was appointed Assistant Secretary. Riley was very much displeased, showed his displeasure in tactless ways, and in May, 1894, was allowed to resign, greatly to the relief of the Secretary.

Doctor Dabney, the Assistant Secretary in charge of scientific work, had been prejudiced by enemies of Riley, and I think must have been partly responsible for making matters disagreeable for him. At all events, when the resignation had been accepted, Doctor Dabney, at the request of the Secretary, began to look into the matter of a successor to the post of chief of the entomological service (then rated as a Division of the Department).

Since I had been first assistant for a dozen years, I naturally expected promotion, but there seemed to be an obstacle. The Assistant Secretary told me that he had been so impressed by certain unfortunate characteristics of Professor Riley that he feared, since I had been his "loyal" assistant for so long, that I was probably the same type of man. He told me that he was going to make inquiries, and in fact he wrote to some of the leaders in entomology and asked them to tell him whom they considered best fitted for the place. Among others, he wrote to S. H. Scudder, A. S. Packard, A. J. Cook

and James Fletcher. Rather to his surprise, I am sure, they all recommended me. So I received my appointment in June, 1894. Two rather interesting things occurred immediately. Secretary Morton had been an old friend of Hon. Bela P. Hubbard, of Detroit, the father of Henry G. Hubbard, an agent of the Division, who happened at that time to be in Washington. The Secretary stated that he wished Mr. Hubbard to be appointed First Assistant Entomologist. This caused trouble at once, since C. L. Marlatt, who had been brought to Washington from Kansas by Professor Riley and who had worked with great intelligence and assiduity and who had ranked next in order, thought that the first-assistantship should be given to him. I agreed with him thoroughly, and talked the matter over with Hubbard who gladly volunteered to go to Secretary Morton and advocate Marlatt's appointment, stating that he himself was a landed proprietor in Florida and that his interests were mainly in that State. The result was that Marlatt received the appointment.

Another interesting development was E. A. Schwarz' resignation as soon as he heard of my appointment. I had always supposed that he liked me, but I imagine that, possibly fed by jealousy of my increasing influence with Riley (he had been Riley's right-hand man during the Comstock régime), he had gradually become opposed to my way of doing things. Here again Hubbard came to the rescue. He was Schwarz' most intimate friend, and having, fortunately, a good opinion of me, he begged Schwarz to withdraw his resignation. This he finally did, and during the many years that we worked together after that there has never been evident to me the slightest trace of the antagonistic feeling that must have existed to a very marked degree during the closing years of the Riley administration.

Here is an interesting incident connected with the change of personnel: Secretary Morton, familiar with the history of the service, feared that at the expiration of the first Cleveland administration Professor Riley would repeat his effort, which had been so successful in 1881, to regain the office; and consequently induced President Cleveland to cover all the chiefs of scientific divisions in the Department of Agriculture, except the Weather Bureau, into the Civil Service by executive order. This is one of the instances of how comparatively small things bring about big results; and at the same time it indicates the breadth of President Cleveland's views regarding the Civil Service.

Just at this point it would be well to say something more about the personnel of the Division of Entomology at this time. We have just seen how Hubbard's opinion influenced Schwarz to remain with

the service. Schwarz was a very learned and competent German entomologist who had joined Hagen at the newly founded Agassiz Museum of Comparative Zoology at Cambridge, Massachusetts, in the very early 1870's. Hubbard was a well born, wealthy young man from Detroit, who was a member of the class of 1873 at Harvard. The two men became intimate there, and when Hubbard graduated he took Schwarz with him to Detroit where they started a private laboratory and soon after made an expedition to the Lake Superior region where they collected and afterwards published a joint paper on the Coleoptera of that part of the country. They were very warm friends, and remained so until Hubbard's death in 1899.

In 1881 Hubbard went to Florida for his health, bought a place at Crescent City where he started fruit-growing. He was a very keen entomologist and a wonderful observer. During Comstock's administration of the entomological service of the Department of Agriculture, Riley, from the outside, watched his (Comstock's) movements and his publications with keen interest. He realized that Comstock had scored a big point in his Citrus insect work, and especially in his work upon scale insects; and he began to lay plans. On his return to the Department in the spring of 1881, he began to put them into effect. He suggested to Hubbard that he should prepare a report on the insect enemies of the orange. Hubbard liked the work and threw himself into it with enthusiasm. As a result of his labors he produced in 1885 a very remarkable report entitled "Insects Affecting the Orange," which was published by the Department as a special report of the Division of Entomology.

It is doubtful whether the Department of Agriculture had ever published quite such an admirable report. It was very fully illustrated, and covered more than 200 pages. Looking over it today, one marvels: the writer knew his subject so well; he was so keen an observer, and so broad a thinker, and yet at the same time he was so practical. It is a monumental publication, and today stands out among the publications of the Department. Hubbard knew his insects and he knew his crop. He knew the parasites of his insects, and he knew the plant diseases. Moreover, he knew enough of chemistry and enough of machinery so that he was able to point out exactly what the orange grower could do and should do. Nothing at all equal to it had been published in any country.

The Italian Government two years later published a big report entitled "*Studi Botanici sugli Agrumi e sulle Piante Affini*," by O. Penzig, which included an account of the orange insects of the

Mediterranean region and in the course of which the author quoted Hubbard and copied one of his plates.

Theodor Pergande, as has been stated, came from Missouri with Professor Riley and stayed in the service until his death, March 23, 1916. He was a man of slight education, who had been a mechanic in Germany and who had come to this country just at the outbreak of the Civil War. He entered the Union army as a private, served through the war, and at its close became a worker in a gun factory in or near St. Louis. He had been a collector of insects since boyhood, and was a very keen observer. On one of his Sunday collecting trips he met Otto Lugger, also a German by birth, who at that time was an assistant to Professor Riley in his office as State Entomologist of Missouri. Lugger was about to resign his position, and introduced Pergande to Riley, and got him the job as his successor. Pergande was a small man with a large beard, not too careful about his personal appearance, but a positive genius in his work on the life history of insects. He was invaluable to Riley and invaluable to the entomological service at Washington. For many years he kept the main insectary notes of the service; and the great bulk of the life history work published in the many entomological publications of the Department for many years was based upon his careful notes and observations. Dr. Cooper Curtice, of the Bureau of Animal Industry, once said (I think it was in the late 1880's) "The Division of Entomology without Pergande would be like the play of Hamlet without Hamlet." Dr. Walther Horn, in his review of Escherich's book on applied entomology in the United States, said (he himself had visited Washington many years before): "This model organization is described in its main features, and its principal workings are explained one by one. Something I have missed in this connection. It appears to me that Theodor Pergande should be allowed a more prominent place. He had certainly deserved it." (Translated.) Pergande had many friends and admirers who estimated him at his true worth. No one who worked with him will ever forget him. He received little public credit for his work, but his very few published papers show his great knowledge and keen ability. He had a delightful sense of humor, and told fascinating stories of his experiences. He had strong likes and dislikes as to persons, and was very outspoken. His mind began to fail toward the end, and he had a number of curious hallucinations. He told me, for example, in 1915, of a trip he once took to Japan with the son of the Emperor, and with much detail recited his extraordinary experiences in the way of receptions and so on. All this he imagined. For some months before his death he was under

the impression that he was receiving a pension from the government since a year or so before he had seen in the newspapers that Congress was considering a Civil Service retirement bill. He died, however, long before such a bill became a law.

Otto Lugger, who had been with Riley in St. Louis and who had left him, went eventually to Baltimore where he became Curator of the Maryland Academy of Sciences. In 1885 an opportunity offered and he became an assistant in the Division of Entomology, resigning in 1888 to become State Entomologist of Minnesota. He was a very well trained entomologist, a great humorist and a man of very great information. He assisted in a number of important investigations and left behind him important notes which were subsequently used. His administration of his office in Minnesota was most successful, and his annual reports were sound, extensive and widely read.

Charles L. Marlatt came to Washington in late 1888. Professor Riley needed another artist. He had been struck with the drawings made by Marlatt to illustrate certain bulletins coming from the Kansas State Agricultural College, and offered him a position in Washington largely with the idea that he would use him in drawing insects. When Marlatt appeared here, however, Riley found that he was far too good a man in other directions to be allowed to use his time in drawing, and Marlatt quickly made an important place for himself in the service. About this time Professor Riley was able to secure the services of Miss Lily Sullivan as an artist, who soon became very proficient at that work, and so he was free to use Marlatt in other directions. Marlatt's attention was turned almost immediately to the subject of insecticides and insecticide apparatus. One of his early tasks was to go to Michigan and investigate the A. J. Cook side of the kerosene-emulsion controversy. He showed himself in that matter, as in all others afterwards, clear-minded, just, and extremely capable. His contributions to the early volumes of *Insect Life* and his papers read before the Entomological Society of Washington showed him to be a coming man with an important future. Before coming to Washington he had taken his master's degree at the Kansas State Agricultural College and was an assistant to Prof. E. A. Popenoe in the teaching department. In 1922 he was given a doctorate in science by the same institution. When Riley resigned in 1894, Marlatt became the First Assistant Entomologist, later Associate Entomologist, holding this position until 1927 when he became Chief of the Bureau. In the meantime, in 1912, he became the first Chairman of the just-created Federal

Horticultural Board, taking on the extremely important and onerous duties of that position. All through his career he has shown himself clear-headed, able, and versatile to a degree. He early made a mark in taxonomic work by his fine studies in the Coccidae and in an important group of the Tenthredinidae. He traveled extensively and got an early world-view of economic entomology. His practical and fertile mind has been constantly at work in the solving of big problems, and no man could be better fitted by ability and experience to conduct the affairs of the now very large Bureau of Entomology.

In the summer of 1891 Frank H. Chittenden was appointed. He had been a prominent member of the Brooklyn Entomological Society and the editor of its publications. He had been educated at Cornell University, studying under both W. S. Barnard and J. H. Comstock. Although a coleopterist, he had a broad knowledge of insects and filled an important niche in the service. Later he became a man of prominence and built up a large branch of the service. His many articles and reports showed great care and minute knowledge. It is probable that no one had a greater knowledge of the insects affecting truck crops in the United States than did Chittenden.

One of the most interesting members of the force in the early days was Albert Koebele. He was born in Germany in 1852; came to this country when a young man, and at the time of his appointment he was living in Brooklyn where he was a member of the Brooklyn Entomological Society. In the winter of 1881 Riley attended a meeting of that Society and was greatly impressed by the beautiful condition of certain specimens exhibited by Koebele. He offered him an appointment, which Koebele accepted, and he came to Washington early in 1882. He became at once an extremely valuable office worker and a still more valuable field man. He was sent to the South to make observations on the cotton caterpillar and related species, and in November, 1882, went to Brazil with the late John C. Branner largely to investigate cotton pests, with the Brazilian origin of the cotton caterpillar distinctly in mind. The expedition returned in 1883, and the results of Koebele's work as shown by the specimens he brought back were marvelous. He remained in Washington two more years, and then, after an unfortunate love affair, asked to be transferred to some distant place. He was sent to California where he conducted a series of very interesting studies and where he performed many experiments with different washes against the white, or fluted, scale of the orange. While he was engaged in this work Riley succeeded in tracing the origin of this scale and learned from one of his correspondents

(the late Frazer S. Crawford) that the scale insect, although present in Australia, was not injurious there. Riley immediately deduced that there must be important natural enemies in Australia which kept the scale in check, and in fact he received from Mr. Crawford specimens of a little parasitic fly (subsequently described by Williston as *Lestophonus iceryae*) which he considered as of great importance. As there was in force at that time a provision in the appropriation bill forbidding travel by employees of the Department of Agriculture in foreign countries,¹ Riley had great difficulty in arranging to send a man to Australia to investigate the situation and to secure a shipment of these flies for sending to the United States. But obstacles as a rule only inspired Riley to further efforts; and in this case he finally, after placing the matter before the Department of State, secured permission to send an expert agent to Australia under funds provided for an American exhibit at an international exposition to be held the following year at Melbourne. This, however, was not gained on the sole merits of the case, but there had to be a *quid pro quo*, and Riley was obliged to send another assistant to report on the agricultural features of the exposition, for insertion in the report of the United States Commissioners. So finally Koebele (selected both because he was in California and because of his remarkable skill as a field man) was sent as the expert, with F. M. Webster as the reporter for the agricultural features of the exposition. The result of it all was that the *Lestophonus* was found to be comparatively unimportant and that the wonderful ladybird, *Novius (Vedalia) cardinalis*, was found and sent to California where, with proper care, it multiplied, was liberated, and saved the Citrus industry of California from approaching destruction by the scale.

This dramatic and extremely useful bit of work was a great thing for scientific economic entomology. So striking a success may probably never again be achieved in this country. It had its bad effects on the economic entomology of California, and it aroused many false hopes, but it made Koebele. I have, however, told the story of the remainder of his life in a long obituary notice published in the Journal of Economic Entomology for 1925 (Vol. 18, pp. 556-562) and none of it will be repeated here.

Daniel W. Coquillett comes in here. He was born in Illinois, was an entomologist by choice, and had been an assistant to Rev. Cyrus Thomas during the latter's term as State Entomologist. His health

¹ It was a matter of common knowledge that this provision was inserted in order to put a stop to Riley's frequent foreign travel.

failed, however, and he went to southern California to recuperate. The climate agreed with him, and in 1887 Professor Riley took him on as a field agent and used him in making certain observations on injurious insects of southern California. He was living at Los Angeles at the time when Koebele started for Australia, and was charged with the preparations for the receipt of the parasites or predators when they should arrive. He had a temporary structure built over an orange tree badly infested with *Icerya*, and cared for and liberated the *Vedalias* when they arrived. Later he was instrumental in the early development of the hydrocyanic-acid gas fumigation of orange trees infested by other species of scales, and later still, his health apparently permitting, he was brought to Washington where he spent the rest of his life doing taxonomic work with the *Diptera*.

E. A. Schwarz deserves further especial mention. He was always one of the most valuable men in the service. He did an immense amount of work for Riley, whom he greatly admired. He contributed frequent and important articles to *Insect Life*, and was one of the mainstays of the Entomological Society of Washington after its foundation in 1884. He was always universally respected on account of his broad and intimate knowledge of very many aspects of entomology. He was extremely helpful to the other workers. He quickly gained the admiration and respect of the younger men as they joined the force, and this feeling of great admiration and great respect increased as the years went on. His connection with the force has been of the greatest advantage to the service. It has helped greatly to give it an atmosphere of scientific authority. He played an important part in many of the principal investigations, notably in the cotton boll weevil work just after Riley's retirement. He died October 15, 1928. The character of the man and the amazing extent of his knowledge can best be understood if one reads his long series of letters published in *The Journal of the New York Entomological Society*, Vol. 37, No. 3, September 1929, pp. 181-392.

Of the other younger men during the Riley administration should be especially mentioned W. B. Alwood, who assisted in the important work in the summer of 1886 on the hop aphid; C. H. Tyler Townsend, who came as a very young man to assist in the office work in 1888; A. B. Cordley (now Director of the Oregon Agricultural Experiment Station); F. W. Mally (now in Texas in private work), and Nathan Banks, for many years invaluable assistant in taxonomic work with groups with which the rest of us were not familiar (now Curator of Insects in the Museum of Comparative Zoology at Cambridge).

During the early 1880's Congress made special appropriations for the encouragement of silk culture, and Philip Walker was engaged as a Special Agent to take charge of the work. He knew silk culture in France, was a relative of General Serrell who had invented the Serrell electric reel, and was a practical, clear-minded man of good scientific training. He showed himself to be enthusiastic and far-sighted and very honest. He did not hesitate finally to announce his opinion, after several years of work, that silk culture could not be taken up profitably in this country without an import duty on raw silk.

Under Riley also was started the bee culture work, first under a field agent, Nelson W. McLain, who studied especially the effects on the honey industry of the arsenical spraying of fruit trees against the codling moth, and later under Frank Benton who came to Washington and started experimental and propaganda work.

WORK IN THE STATES, 1878-1888

In the foregoing sections we have made a somewhat arbitrary chronological division. Under the head of Early History and Early American Writers, we have considered the subject down to 1878 when Riley came to Washington, bringing Pergande, and Schwarz and I joined him. Then, after a consideration of insecticides, journals, teaching of entomology, and the work of the United States Entomological Commission, we took up entomology under the Federal Government from 1878 to 1894. The only reason why the latter date was taken as a stopping place was that it was the final year of Riley's administration; and the extraordinary cumulative events of the next eight or ten years seem obviously to demand separate consideration. There is no doubt of the tremendous importance of the passage of the Hatch Act and the founding of the State Agricultural Experiment Stations in 1888, and therefore of the beginning of a new epoch at that time. There remains, therefore, for consideration the work that was being done in the country at large (aside from the Federal Government work) in the period from 1878 to 1888.

During this period some very good work was done and by some admirable workers, but in the light of later history it is difficult to realize how little we really knew and how little attention was paid to the increasingly important question of insect injury.

During the decade in question (1878-1888) a number of the men who had already begun to write and who are mentioned in a previous chapter continued to publish, and new writers made their appear-

ance in print. The importance of the State Agricultural Colleges, founded as a result of the Morrill Land-Grant Act of 1862, was gradually growing, although very slowly indeed. First a general teaching of several sciences by one man, so-called natural history courses, were offered, and from these very slowly developed teachers who were able to devote more and more of their time to entomology. We have shown this in our section on teaching. Of the writers mentioned in our chapter on early history, Miss Mary E. Murtfeldt, F. M. Webster, H. G. Hubbard, C. H. Fernald, Cyrus Thomas, S. A. Forbes, George H. French, J. H. Comstock, Emily A. Smith, A. J. Cook, J. A. Lintner and A. S. Packard continued to publish after 1878, some of them dropping out shortly after that date, and others continuing for many years. Several of them we have considered rather fully in the earlier chapter and nothing further need be said about them here. This holds for Cook, Lintner, Miss Murtfeldt, Hubbard, Webster, and Fernald. Something must be said, however, about the others.

We have mentioned in a single paragraph the work of Prof. S. A. Forbes who began to publish in 1876, and in that paragraph (written in April, 1928) he was recorded as still living. Very recently (March 13, 1930) he died, at the age of 86. The value of Professor Forbes' work could hardly be overestimated. He was a sound worker and an advanced thinker throughout his whole career, and was a leader among all the American entomologists. He succeeded Cyrus Thomas as State Entomologist of Illinois in 1882, and speedily became known as one of the strongest men in the field of applied entomology in the United States. I honestly think that it would have been for the good of the country had he succeeded Riley in 1894 as Entomologist of the United States Department of Agriculture, and I think there is no doubt that he could have had the position had he wished it. I do not know that his name was considered by the Secretary of Agriculture, but I myself wrote him asking whether he would consider the position, not wishing to obtrude my own claims ahead of his. He replied, however, that he was so greatly interested in his Illinois work that he much preferred to stay there. His career has been an admirable one; it has dignified the applied science and has helped no end to bring about its present important standing. An admirable review of his career, by Henry B. Ward, is published in the number of *Science* that comes to my desk as I write this (*Science*, April 11, 1930, Vol. 71, No. 1841, pp. 378-381).

Lawrence Bruner was a man who became prominent during the period we now have under consideration. His first article was pub-

lished in 1883. He was then connected, as he was practically his whole active life, with the University of Nebraska. He taught natural history; was at first interested in ornithology (he was a good taxidermist); and was engaged as a special agent of the United States Department of Agriculture to make observations, usually in the summer, on the Rocky Mountain locust in the various States adjoining Nebraska—in fact, in the whole Northwest. His last report in this capacity was published in the Annual Report of the United States Department of Agriculture for 1887. He became very greatly interested in the Orthoptera and widely known as an authority in that group. Later, when the Argentine government appealed to me to recommend an American to go to Argentina and advise concerning migratory locusts, I had no hesitation in recommending Professor Bruner, who spent some time in that South American country and published an excellent report. On reaching retiring age, he went to California where he still lives.

An interesting incident connected with Professor Bruner may be told. He came to Washington on his wedding trip. He had married a charming Nebraska girl. Some time later I received a telegram from him announcing the birth of a daughter. I wired a reply of congratulations, and added that if he would name the daughter Psyche the Division of Entomology would stand as godfather. This despatch was not answered, but I learned a year later that his little girl bore the unusual name of Psyche; whereupon the entomological force in Washington sent her a silver cup. It may be interesting to know that this little girl eventually became the wife of Harry S. Smith, so well known to all American entomologists.

While Prof. J. H. Comstock continued to publish occasionally on injurious insects after his return to Cornell University, he soon began to devote his attention to the non-economic aspects of the science of entomology, and the economic work was taken over largely by his assistant, M. V. Slingerland, who, however, did not begin to publish until the year when the experiment station law came into operation. I imagine that the fifteen-thousand-dollar fund allotted to the Cornell station enabled the definite employment of Slingerland, at that time a student assistant, and facilitated his work which was very notable. His publications soon became models for the on-coming generation of applied workers.

Prof. E. A. Popenoe, teaching entomology at the Kansas State Agricultural College, published occasional articles between 1880 and 1882.

Dr. John B. Smith, coming to Washington in 1884, published several articles on economic entomology before he was appointed Entomologist to the State of New Jersey on the founding of the Agricultural Experiment Station. Doctor Smith was primarily a taxonomist, first in the Coleoptera and later in the Lepidoptera. While he came to Washington for work largely in the United States National Museum where he was Assistant Curator of Insects under Professor Riley who was then the Honorary Curator, he was called upon for work in the Department of Agriculture and, if I remember rightly, was paid from the funds of the Department of Agriculture. One of his notable pieces of economic work at that period was his report on cranberry insects. Later, in New Jersey, he became one of the foremost of the State workers and published many admirable reports and bulletins.

Prof. Clarence P. Gillette, at first Assistant Entomologist to the Michigan Agricultural College (1886-87), later at Ames, Iowa, and still later and for many years head of the Department of Zoology and Botany in the Colorado Agricultural College and Entomologist of the Colorado Experiment Station, and still later Director of the Colorado Experiment Station, began to publish while still at Michigan, and his first recorded paper was published during the period we are now considering in this chapter. It was on the subject of mites and was published in 1887 in the Annual Report of the Michigan Horticultural Society.

Prof. F. H. Snow, teacher of natural history in the University of Kansas and afterwards President of the University, was working and publishing concerning insects nearly until the time of his death, and was responsible for the great interest in the destruction of the chinch bug by a fungus disease that was much talked about in the late 1880's.

Harrison Garman, working in Illinois and later for many years connected with the Kentucky Agricultural Experiment Station, began to write in 1882 and was the author of several important papers.

Many articles on entomology were published by a rapidly increasing number of writers, largely in the agricultural journals, during this period, and a few of the workers in systematic entomology occasionally published a note upon some injurious species. V. T. Chambers, a well known writer on Microlepidoptera, W. L. Devereaux, George Dimmock, a broad biologist entomologically interested in the Diptera, C. H. Dwinelle of California, Henry Edwards, the actor and famous collector of Lepidoptera, G. H. French of Illinois, a Lepidopterist for the most part and the author of a book on butterflies, F. W. Goding who later entered the United States Consular Service but

who wrote in the 1880's of leafhoppers, John Hamilton, the Coleopterist, Joseph Leidy, the biologist, Rev. Samuel Lockwood, a New Jersey clergyman interested in entomology, Joseph Voyle, a southerner and at one time an agent of the United States Department of Agriculture, C. S. Minot, the eminent biologist and embryologist, and Edward Burgess, the well known Dipterist and yacht designer—all published on economic entomology in the early 1880's.

In spite of all this, when one looks back, there was after all, as we have already stated, comparatively little economic work being done outside the Federal organization. Entomologists, it is true—amateurs—were abundant, and I think even more abundant than they are now, but we must remember that there were absolutely no books on economic entomology. The publication of the first edition of Prof. William Saunders' "Insects Injurious to Fruits" in 1883 was a great event. It was written by a Canadian, it is true, but it was published by an American firm (J. B. Lippincott Co. of Philadelphia). And it was not until after the Agricultural Experiment Stations and the Agricultural Colleges were in full swing that other books began to be published; and there has followed, of course, a series of them that would more than fill Doctor Eliot's famous five-foot shelf—all excellent books and constantly growing bigger, culminating last year in the big book entitled "Destructive and Useful Insects" by Metcalf and Flint.

But there were several active entomological societies, and the big collections were growing rapidly.

THE HATCH ACT AND THE STATE AGRICULTURAL EXPERIMENT STATIONS

A number of things happened toward the close of the last century which not only emphasized the importance of applied entomology in a very extraordinary way but which also helped to place the United States in better condition to fight the destructive influences as they developed. In the latter category belongs the passage of the so-called Hatch Act by Congress in the late eighties which resulted in the organization in the spring of 1888 of the State Agricultural Experiment Stations.

Down to that time New York, Illinois, and Missouri had been practically the only States to support distinct and consecutive investigations in economic entomology. A number of the State horticultural and agricultural societies had, as we have seen, published reports on injurious insects, and I believe that Doctor Packard was paid for his Massachusetts reports. The State Board of Agriculture of Penn-

sylvania had handled its economic entomology by means of an officer who held an honorary commission. This position was held by Dr. S. S. Rathvon, and I have elsewhere called attention to the fact that in 1880 J. T. Humphreys wrote to Washington on letterheads which read "Late Naturalist and Entomologist to the Georgia Department of Agriculture," but I have not been able to learn the details of such employment.

Although the State Experiment Stations were not organized until the spring of 1888, a number of entomologists were soon appointed and active work began practically in the month of February. It would be difficult to overestimate the value to the country at large of this action on the part of the Federal Government. It is true that there was a dearth of trained entomologists and that it became necessary for men to undertake the work who had had practically no training in entomology at all, or for entomologists who knew nothing at all about agricultural entomology to step in and try to meet the new needs.

By 1894, 42 States and Territories had employed persons to do entomological work, while the number of experiment station workers who had published entomological bulletins or reports reached 77. Not all of these writers, however, were officially designated as entomologists to the stations, but there were 28 who were so designated, and it is reasonably sure that there were not 28 qualified agricultural entomologists in the country. The others who wrote were botanists, horticulturists, physiologists, zoologists, superintendents of farms, directors and vice-directors of stations, mycologists, and special agents.

But the output was not bad. It could not from the start include original research. By 1894 there had been 311 publications containing agricultural entomology. It is interesting to look at the entomological publications which appeared in the first few months. They were not at all bad, although, among the authors, Hulst in New Jersey and Ashmead in Florida had been simply systematists while Tracy in Mississippi was a botanist. However, Weed in Ohio, Popenoe in Kansas, Perkins in Vermont, Fernald in Massachusetts and Luggar in Minnesota had already shown themselves to be, in one position or another, capable of good research work in applied entomology.

Between 1894 and 1907 (the next time that I had occasion to survey the Experiment Stations field) affairs with the Experiment Stations had shaped themselves into good form, and entomology, among the other sciences applied to agriculture, had begun to receive greater

recognition and more experienced handling. The men in charge of entomological work had had 13 years more of experience, and new workers had been added from the colleges where the training of entomologists had really begun for the first time between 1888 and 1894. In my 1907 survey I found that the number of entomological publications of State Agricultural Experiment Stations had reached 1,300, of which 424 were reports, 839 were bulletins, 34 circulars and 3 apicultural bulletins. The stations had issued 941 reports in all, of which about one-half, on a rough estimate, were entomological or contained some entomological matter. The subjects of the bulletins and circulars were found to be about as follows: insecticides and machinery, 251; compiled accounts of insects, 259; more or less original observations, 356.

Obviously, in the course of the 13 years, bulletins based on original observations had increased very considerably in number. It is perfectly obvious also that, not only at that time but even today, compiled bulletins often have a greater practical value to the constituency of a State Experiment Station than the bulletins giving the results of original work. The original-work bulletins advance the condition of the science; the compiled bulletins extend the knowledge of the results so as to make them more valuable to the people at large. At that time the work of Forbes in Illinois, Felt in New York, and Smith in New Jersey, among the State Entomologists, stood out. And from that time on the quality and quantity of work done by the State and Experiment Station officials have increased and improved rapidly. Larger funds have been given to these institutions by their respective States and by additional Federal appropriations. The State men and the Federal men have come together year after year, and cooperative work is going on in many directions. Many of the State men have made sound scientific reputations, and the value of the State work as a whole is very great.

The Office of Experiment Stations of the Federal Department of Agriculture early began publication of the Experiment Station Record, in which abstracts of all the publications of the Stations are given from month to month. This publication has been of very great value. Dr. W. A. Hooker, who for many years has been the editor of the entomological and veterinary portions of the Record, has been good enough to investigate for me the number of contributions on entomology by experiment-station entomologists, including both State and insular Federal stations, between the time of my 1907 summary down to the end of June, 1928. He finds that there have been during this period of 21 years 2,844 such publications. This account includes

all entomological contributions appearing in bulletins, circulars, reports, and periodicals. Many of the reports by station entomologists as State Entomologists, however, include separate articles which if counted would greatly increase the total number. The State Departments of Agriculture contributions that have appeared under the authorship of station entomologists have been included; also the contributions from the Illinois Natural History Survey by Doctor Forbes and his associates have been included, since the Survey in Illinois takes the place of the Station Department of Entomology. I have made no effort, nor has Doctor Hooker, to check out the number including original research, but it must be very great. In practically every station in the country original research has been going on for years and many valuable and far-reaching discoveries have been made by the State people. There have been times during all this progress when there have been rumblings of dissatisfaction among the State people with certain actions and apparent policies of the Federal Department, but on the whole the feeling in entomology has been one of harmony, and so far as I can see, looking back from the close of 1928, there have been no misunderstandings that have retarded the advance of investigation work. At this time of writing the sky is especially clear and there is not even the faintest suggestion of a cloud.

I am well aware that this narration cannot be considered a thoroughly competent history of American economic entomology without much longer consideration of the work done at the State Agricultural Colleges and State Experiment Stations and by the scarce State Entomologists, and I can, for lack of space, do little more than generalize concerning the work done by these institutions and by the later men. I have spoken more of the Federal work on account of my intimate association with it, but of the men who have grown up in the service of the States and who have established strong reputations for themselves, who have published the results of sound research work and have helped enormously to bring about the present conditions, I cannot enter into detail. I should like to devote some space to the consideration of the work of many of the younger men of prominence, like those who have served in the last 20 or more years as Presidents of the Association of Economic Entomologists (these will be specified in a later chapter), of men (to mention some whose names have not yet appeared in this account) like W. E. Britton of Connecticut, W. C. O'Kane of New Hampshire, Henry Fernald of Massachusetts, E. P. Felt of New York, Wilmon Newell of Florida, E. D. Ball of Utah and Iowa, W. E. Hinds of Louisiana, Miss Edith M. Patch of Maine, T. J. Headlee of New Jersey, P. J. Parrott of New York, Franklin

Sherman of North Carolina and South Carolina, R. W. Harned of Mississippi, H. A. Morgan formerly of Louisiana, J. J. Davis of Indiana, George A. Dean of Kansas, R. A. Cooley of Montana, R. H. Pettit of Michigan, W. B. Herms, E. O. Essig and Harry S. Smith of California, and perhaps a score of others. The portraits that are published with this account show the faces of the older ones among these men, but, if I am not mistaken, there is not a man shown on these plates who is less than 55 years of age; and there is an army of younger men who cannot be mentioned except by an expression of heartiest praise of their important and often self-sacrificing work.

The apparent age restriction mentioned in the preceding paragraph applies only to the American entomologists. There are so many of them. As to the economic entomologists of the rest of the world, since they are less numerous and since work in economic entomology is really of much more recent date in other countries, younger men are necessarily shown on the plates.

THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Another event which had a striking influence on the development of applied entomology to its present rank in the United States was the founding of the Association of Economic Entomologists in the summer of 1889. The State Agricultural Experiment Stations had been organized for little more than a year, but so many entomologists had been engaged for this practical work by the new stations that the desirability of an association was evident. The original suggestion for the formation of such an association, I think was made by Professor Riley in the January number of *Insect Life* for that year. He went to Europe in the late spring and remained abroad until the following October. During his absence the organization was effected. The meeting of the American Association for the Advancement of Science was to be held in August, 1889, at Toronto, and James Fletcher, the Dominion Entomologist, was the President of the Entomological Club of that Association. It was the obvious thing for Fletcher to issue a call, and as he came to Washington on official business in July he and I together drafted a constitution for the proposed association and it was organized at Toronto in August. The men attending the organization meetings were Prof. A. J. Cook of Michigan, who acted as chairman, Dr. John B. Smith of New Jersey, Secretary, Prof. C. W. Hargitt of Syracuse University, Mr. E. P. Thompson, a mathematician who was present more or less by accident, Prof. C. M. Weed then of the Ohio Experiment Station, and Prof. Harrison Garman, just appointed to the Kentucky Experiment Station.

and the writer—all from the United States. The Canadians present were Dr. C. J. S. Bethune, Dr. James Fletcher, Mr. E. Baynes Reed, and Mr. H. H. Lyman. All of these became charter members except the Canadian Mr. Lyman and the American Professor Thompson. Other charter members, however, were included as follows: Dr. William Saunders of Canada, Prof. S. A. Forbes of Illinois, Dr. J. A. Lintner of Albany, New York, Prof. J. H. Comstock of Cornell University, Prof. F. L. Harvey of Maine, Prof. M. L. Beekwith of Delaware, Prof. F. M. Webster then of Purdue University, Prof. P. J. Campbell of Georgia, Prof. E. J. Wickson of California, Prof. C. W. Woodworth of Arkansas, Prof. Otto Lugger of Minnesota, Prof. C. P. Gillette of Colorado, and Prof. Herbert Osborn then of Iowa. All of these men were distinctly entomologists with the exception of Professor Wickson who was at that time Lecturer on Dairy Husbandry and Agriculture at the University of California and who afterwards became Associate Professor of Agriculture, Horticulture, and Entomology, still later becoming Dean of the Agricultural College and Acting Director of the California Agricultural Experiment Station; and I think that at one time he was the editor of the famous agricultural newspaper known as *The Pacific Rural Press*.

Beginning in a small way, the Association grew steadily. The growth of the Federal Service and the greater opportunities for research given by the States and the Agricultural Colleges increased the number of men turning their attention to this branch of work (rather rapidly when we look back and review the progress).

It is unnecessary to detail the steps that have brought about the present large, efficient, helpful and very important organization as it exists today. It was until 1913 the only organization of its kind in the world, but in that year Dr. K. Escherich, after a visit to the United States, organized the German *Verein für Angewandte Entomologie* which we shall describe later, in the section on Germany.

Looking back at the early meetings of the Association, it is plain that while there was much interest and enthusiasm among the members, little of the prophetic was shown in the addresses given at the annual meetings. The enormous scope of the problems confronting humanity and their extremely serious character do not seem to have been realized in those days. We met (and there were lamentably few of us then) to talk about comparatively few individual things that were, or bid fair to be, of general interest. When there were 20 of us together, we felt populous; and we met but once a year. There were many dull papers on "The Insects of the Year" or some similar title. But our interest was vivid, and it increased as time went

on and we realized more and more, not only the importance of our vocation and its multitudinous aspects and contacts, but also there began to dawn upon us the disturbing thought that conditions in a broad way were growing worse instead of better.

For the first 19 years after the founding, the Proceedings of the annual meetings of the Association were published either in *Insect Life* or in the bulletins of the entomological service of the United States Department of Agriculture. By 1907, however, the Association had grown so large and so strong that it began the publication of the *Journal of Economic Entomology*. The 20th annual meeting in December of that year had an average attendance of 90 at its several sessions, and the list of members showed 257 names. The *Journal* showed its merit at the start. The opening number covered 80 pages. At the present time (April, 1928) it has passed through 20 volumes, and the first number of Volume 21 covers 248 pages; and the members of the Association as listed in this number reach nearly 1,000.

Not only has the Association developed in numbers and in publications, but it has broadened out in its organization. It now has its Pacific Coast Branch, its Cotton States Branch and its Eastern States Branch. The main Association has always held its meetings at the time and place of the annual meetings of the American Association for the Advancement of Science, and therefore changed the time of its meetings, with the old Association, from August to the week that includes January 1st, now known generally as "Convocation Week." It may be stated incidentally that the term "Convocation Week" has been adopted by the leading universities and hence incorporated in the leading American dictionaries to mean a week during which the learned societies hold their meetings. University schedules have been altered so that the attendance of teachers on these meetings during this week will cause no interference with their college duties.

For the last 26 years, therefore, the main Association has met during Convocation Week; but it seemed desirable for the branches to meet during the growing season, and hence there have been opportunities for members of the Association to come together during the summer time, and therefore for members on the Pacific Coast and in the far South to keep in closer touch with the Association and its work than if they were prevented by long distance from frequent attendance at the meetings of the main Association. There are now three such regional branches.

Moreover, the Association has kept itself well up to date by means of standing committees which have exercised a constant oversight

of the whole field. There are, for example, a committee on policy,¹ one on nomenclature, one on membership, one on the Journal, one on the United States National Museum, one on the Insect Pest Survey, and so on. The Association is represented on scientific organizations of broader scope, as for example, on the National Research Council, in the Council for the American Association for the Advancement of Science, in the Council of Union of American Biological Societies, on the board of trustees of the Tropical Plant Research Foundation, and on the board of trustees of the Crop Protection Institute, the last-named two organizations being in a way children of the National Research Council.

Not long after the passage of the law creating the Federal Horticultural Board (1912) it was deemed desirable to establish two sections of the main Association to hold separate programs at the annual meetings, namely the Section of Horticultural Inspection, including all entomologists engaged in this kind of work, and the Section of Apiculture. These sections have carried out separate programs at the annual meetings of the main Association. Another section—Extension—has since been added.

Another noteworthy thing accomplished by the Association of Economic Entomologists has been the taking up of the "Bibliography of American Economic Entomology" at the point where it seemed unlikely that the Federal Bureau would continue it for some time. Under the title "Bibliography of the More Important Contributions to American Economic Entomology," eight parts had been published by the Bureau down to January 1, 1905. In 1917 there was published by the Association what is really a continuation of this bibliography although arranged differently. The first part was entitled "Index to the Literature of American Economic Entomology, January 1, 1905, to December 31, 1914." The compilation was prepared by Mr. Nathan Banks of the Bureau of Entomology, who had done the latter parts of the "Bibliography." The preparation, then, was the work of the Federal Bureau, but the *publication* of the part, covering 323 pages, was done by the Association. This part was followed by a second, covering the period from January 1, 1915, to December 31, 1919 (published by the Association in 1921). And again, a third part, covering the period from January 1, 1920, to December 31, 1924, was prepared by the Bureau and published by the Association in 1925. Parts 2 and 3 were compiled by Mabel Colcord, Librarian of the Bureau, and edited by E. Porter Felt for

¹ The duties of this committee were transferred to the Executive Committee in 1928.

the Association. The fourth part is now in course of preparation. A glance at the third part, with its 441 double-column pages simply listing the topics treated during the period of five years, gives one a good idea of the really immense amount of work in economic entomology done in North America during that period.

While it is true that the Review of Applied Entomology, published by the Imperial Bureau of Entomology in London and which was started in 1913, covers American entomological publications as well as those of the rest of the world, the American Index of the Association, containing only indexed titles, is much more complete for North America and perhaps more handy for speedy reference.

At the present time, just as I am completing this volume, the Association so far exceeds our original anticipations in every respect that it seems marvelous. The Journal for February, 1930, covers over three hundred pages and is illustrated. The membership list totals 1150, of which 51 are foreign members. This especial number includes the proceedings of the annual meeting held December 30, 1929, to January 1, 1930, at Des Moines, Iowa, and it also includes the proceedings of the meeting of the Southern Branch of the Association held in New York City November 21 and 22, 1929. I was unable to attend the Des Moines meeting (it was the first one I have missed since the organization of the Association), but I was present at the meeting of the Eastern Branch in New York. The program for the two days at this meeting was crowded with short papers covering a large part of the field of economic entomology and giving accounts of current investigations or of those just closed up for the year. So numerous were the papers that there was almost no time for discussion. I could not help contrasting this meeting with that of the whole Association held 35 years before, just across the river in Brooklyn (August, 1894). That was the year when I had the honor of being President. Then there were 17 members in attendance and eight or ten non-members. And that, mind you, was the annual meeting of the whole Association, while this New York meeting was only one of several geographical sections.

It should be stated that from the very beginning Canadians have shared with the workers of the United States in the whole conduct of the organization. They have held prominent offices. James Fletcher, C. Gordon Hewitt and Arthur Gibson have acted as President. Other countries have been recognized from the start, and their prominent workers in economic entomology have been made members of the Association.

This section may be concluded fittingly with a list of the men who have occupied the position of President.

Presidents of the Association of Economic Entomologists

- 1889 C. V. Riley (Washington, D. C.)
- 1890 C. V. Riley (Washington, D. C.)
- 1891 James Fletcher (Canada)
- 1892 J. A. Lintner (New York)
- 1893 S. A. Forbes (Illinois)
- 1894 L. O. Howard (Washington, D. C.)
- 1895 John B. Smith (New Jersey)
- 1896 C. H. Fernald (Massachusetts)
- 1897 F. M. Webster (Ohio)
- 1898 Herbert Osborn (Iowa)
- 1899 C. L. Marlatt (Washington, D. C.)
- 1900 Lawrence Bruner (Nebraska)
- 1901 C. P. Gillette (Colorado)
- 1902¹ A. D. Hopkins (Washington, D. C.)
- 1902 E. P. Felt (New York)
- 1903 M. V. Slingerland (New York)
- 1904 A. L. Quaintance (Washington, D. C.)
- 1905 H. Garman (Kentucky)
- 1906 A. H. Kirkland (Massachusetts)
- 1907 H. A. Morgan (Tennessee)
- 1908 S. A. Forbes (Illinois)
- 1909 W. E. Britton (Connecticut)
- 1910 E. D. Sanderson (New Hampshire)
- 1911 F. L. Washburn (Minnesota)
- 1912 W. D. Hunter (Washington, D. C.)
- 1913 P. J. Parrott (New York)
- 1914 H. T. Fernald (Massachusetts)
- 1915 G. W. Herrick (New York)
- 1916 C. Gordon Hewitt (Canada)
- 1917 R. A. Cooley (Montana)
- 1918 E. D. Ball (Iowa)
- 1919 W. C. O'Kane (New Hampshire)
- 1920 Wilmon Newell (Florida)
- 1921 George A. Dean (Kansas)
- 1922 J. G. Sanders (Pennsylvania)
- 1923 A. G. Ruggles (Minnesota)
- 1924 A. F. Burgess (Massachusetts)
- 1925 H. A. Gossard (Ohio)
- 1926 Arthur Gibson (Canada)
- 1927 R. W. Harned (Mississippi)
- 1928 W. B. Herms (California)
- 1929 T. J. Headlee (New Jersey)
- Elected for 1930, Franklin Sherman (South Carolina)

¹ In 1902 the date was changed from midsummer to winter, and there were, therefore, two meetings in 1902.

THE STRIKING EVENTS OF THE LAST DECADE OF THE NINETEENTH CENTURY

Following very soon after the establishment of Agricultural Experiment Stations in the United States as the result of the so-called Hatch Act passed by the Federal Government in 1888 and the almost simultaneous founding of the Association of Economic Entomologists, there occurred four events which fixed the attention of the whole country upon the importance of entomological work. The first of these was the discovery of the gipsy moth in Massachusetts in 1889; the second was the discovery of the San Jose scale in the East in 1893; the third was the discovery of the Mexican cotton boll weevil in Texas in 1894; and the fourth was the discovery by Ross in 1898 of the carriage of malaria by *Anopheles*. The first three were events apparently then of importance to the United States only; the last was of great importance to all humanity.

THE GIPSY MOTH

It very often happens that injurious insects, coming from abroad, obtain a foothold in the United States in some way that we are not exactly able to explain. We may know in a general way that it has come in in the course of commerce in plants or plant products, as was undoubtedly the case with the Japanese beetle and the European corn borer, or in the straw packing about fragile imported packages, as may have been the case with the alfalfa weevil.

But with the gipsy moth it seems rather certain that it was brought over from Europe in the egg stage to assist in a scientific experiment that a French astronomer, employed in the Harvard Observatory, was carrying on in the cross-breeding of certain silk-producing caterpillars in the hope of establishing a race that would be resistant to the pebrine disease which was at that time threatening the destruction of the silk industry in France. This man, Leopold Trouvelot, imported egg-masses of the gipsy moth from Europe where this insect had long been known as a destructive enemy to forest trees. By some accident, the insects escaped from his laboratory and established themselves in waste land in Medford near his house. This was in 1869. He notified the scientific public, but nothing was seen of the gipsy moth, which remained, however, gradually increasing, on this waste land until 1889 when a tremendous plague of caterpillars almost overwhelmed the little town. The numbers were so enormous that the trees were completely stripped of their leaves, the crawling caterpillars covered the sidewalks, the trunks of the shade trees, the fences and the sides of the houses, entering the houses and getting

into the food and into the beds. They were killed in countless numbers by the inhabitants, who swept them up into piles, poured kerosene over them and set them on fire. Thousands upon thousands were crushed under the feet of pedestrians, and a pungent and filthy stench arose from their decaying bodies. The numbers were so great that in the still, summer nights the sound of their feeding could plainly be heard, while the pattering of their excremental pellets on the ground sounded like rain. Valuable fruit and shade trees were killed in numbers by their work, and the value of real estate was very considerably reduced. So great was the nuisance that it was impossible, for example, to hang clothes upon the garden clothesline, as they would become covered with the caterpillars and stained with their excrement. Persons walking along the streets would become covered with caterpillars spinning down from the trees. To read the testimony of the older inhabitants of the town, which was collected and published by a committee, reminds one vividly of one of the plagues of Egypt as described in the Bible.

During all this time the Medford people had been under the impression that the insect which they were fighting in their gardens was a native species, and they knew it simply as "the caterpillar" or "the army worm"; but in June, 1889, when the plague was at its height, specimens were sent to the Agricultural Experiment Station at Amherst, and were identified by Mrs. C. H. Fernald as the famous gipsy moth of Europe.

A town meeting was immediately called in Medford, and work against the insect was begun. The next year a State appropriation was made, and very active and intelligent investigations were carried on under continually increasing appropriations until 1901 when, unfortunately, just as the possible extermination of the species appeared to be in sight, the appropriations were stopped and were not renewed for four years. During these four years the insect increased and spread from an area of about 400 square miles to one of 4,000 square miles.

In 1905 the Federal Government was called in, and since that time has made large appropriations annually.

When the fight was rebegun in 1905 it was realized that the opportunity for extermination was gone, and that all efforts should be based upon the ideas of control and prevention of spread. It is a pity that the State appropriations were interrupted in 1901. It is a pity that the Federal Government did not take hold at the start and make every effort to exterminate the pest while it was still confined to the vicinity of Medford. But the government did not do things of

that sort at that time. Appropriations were small and were hard to get. The economical New Englanders were tired of the expensive fight, and it is hard to blame them. Knowing what we do now, it would seem that the Federal Bureau of Entomology might fairly be blamed for lack of foresight in not warning Congress and the other States of the great danger and in not appealing to Congress for funds with which to prosecute radical work. As I look back, the idea seems never to have occurred to us. It seemed to us a State matter which Massachusetts could handle if she would. There is no doubt that prior to 1901 large areas had been so carefully gone over by State forces that the gipsy moth was exterminated locally, and we argued that if this could be done over a number of square miles it could be done over 400 square miles then occupied by the insect.

All this is now, however, vain speculation. The insect has spread gradually, and for a very large part its commercial spread in great jumps has been prevented by quarantine and inspection. Such commercial jumps have occurred, however, in one case as far as Ohio, and in several cases in New York. All, however, have been discovered in time, and vigorous work has exterminated the insect, except in a large New Jersey outbreak which is only now being reduced to such an extent that successful extermination seems a matter of a very few years. This last case by the way was not a commercial jump, but undoubtedly a direct accidental importation from Europe.

But the other New England States have all been invaded, and all of them have passed legislation compelling community and individual work. The Federal Government has occupied itself along the boundary of spread in the effort to hold the pest in check. In the interior, the States have been supposed to control destructive outbreaks. At the present time both New York State and the Federal Government are holding it back along a line extending from Canada to Long Island Sound (virtually the Valley of the Hudson River) which has been termed a "Hindenburg line."

Some years after the gipsy moth was discovered in Massachusetts another European pest, the brown-tail moth, was found to have been imported in its winter webs on rose bushes from Holland and to have become thoroughly established; and the study of this insect and its treatment was included with the gipsy moth work carried on by the State. The brown-tail moth, however, after a comparatively few years proved not to spread so rapidly as the gipsy moth, and to be so easily handled by the cutting and burning of its conspicuous webs during the winter time, and moreover was so readily attacked by

parasites imported from Europe, that it has ceased to be considered as a pest of the first importance.

The operations against these two insects, and especially the gipsy moth, constituted the largest and most continuously active work supported by legislative appropriations that the country had yet experienced. The cotton boll weevil work differed in the fact that the invaded States can hardly be said to have done their share financially, at least in comparison with the New England and bordering States.

The gipsy moth work has accomplished several notable things in addition to what in itself may be termed more or less of a feat, namely keeping it all this time practically within the borders of the New England States. These other things are, first a striking improvement in insecticides. The old Paris green, upon which farmers and fruit-growers had relied during the latter part of the last century, was found, in the ordinary solutions, to be ineffective against the gipsy moth. The vigorous caterpillars of this species, it was found, can consume with impunity almost ten times the quantity of arsenic that would kill any other caterpillar against which it had been used, and larger proportions of arsenic could not be used since the burning of foliage would result. Therefore, in the course of the work of chemists employed by the State of Massachusetts, arsenate of lead was found to be effective and not injurious to foliage. And this substance has been used by the thousands of tons not only in work against the gipsy moth but in orchard work against the codling moth and many other insects.

The second result of the gipsy moth work was the enormous improvement of spraying machinery. In the spraying of tall trees, spray nozzles were soon abandoned, and solid-stream nozzles substituted. The stream of poisoned water thrown up with great force from the powerful machine breaks into the requisite spray long before it reaches the tops of tall trees. All of the features of the machines and of the hose were greatly improved, and it has of late been one of the marvels of applied entomology to see a spraying machine by the roadside in the mountainous regions of southern New Hampshire getting its supply of water from a roadside stream, and, through strong sectioned hose carried up over the top of hills of considerable size, spraying the trees on the other side of the hill, perhaps nearly a mile away.

In the course of the gipsy moth work, entomologists found themselves able to carry out on a very large scale and for continuous years the importation of parasites of the gipsy moth and the brown-tail moth from Europe and from Japan. The funds at their disposal

allowed the entomologists to make very careful studies of these parasites and of the general subject of parasitism among insects. While there has been nothing spectacular in the results of this side of the investigation, there can be no doubt that the importation of many species of these parasites and natural enemies has resulted in great good. A number of them have been established in this country. And the present condition of the woodlands of New England as contrasted with the conditions that existed 20 years ago is attributable in no small part, I believe, to the destruction of both gipsy moth and brown-tail moth by these imported species.

The country has been fortunate in the type of men connected with this work from the start. The fine volume published by the State of Massachusetts in 1896, which is a report of the work of the gipsy moth, and was written by E. H. Forbush, Field Director in Charge of Remedial Work, and C. H. Fernald, Consulting Entomologist, is a model of its kind. Doctor Fernald continued his active interest in the work as a consultant for many years. Mr. Forbush was active until the State appropriations stopped in 1901. When they were resumed in 1906 he was succeeded by A. H. Kirkland, a former student of Professor Fernald's, who grew up with the work and who proved to be an inspiring and efficient executive. Later the work was taken over by the State Forester, but the great emergencies had passed, and little more was needed within the invaded States than more or less routine work.

Of the part that the Federal Bureau of Entomology took in the work, it need only be stated that we entered upon it first in 1905, at the invitation of the State of Massachusetts, and that our efforts were confined for the first few years to the importation of European parasites and their care. Later the Federal Government began to make large appropriations to assist in the prevention of the further spread of the insect; and in the conduct of that work Mr. A. F. Burgess has shown himself to be most efficient and resourceful. He was aided in the quarantine features of the work by Mr. D. M. Rogers, a Massachusetts man, who had been associated with the work from the early days. These quarantine features constituted the first Federal quarantine work against insects done in this country, antedating the establishment of the Federal Horticultural Board by several years.

THE SAN JOSE SCALE

When Professor Comstock, in the summer of 1880, found *Aspidiotus perniciosus* in the Santa Clara Valley of California he was so

impressed by the damage which it was doing that he had no hesitation in applying the specific name *perniciosus* to it, since, as he said:

From what I have seen of it, I think that it is the most pernicious scale insect known in this country; certainly I never saw another species so abundant as this is in certain orchards which I have visited. It is said to infest all the deciduous fruits grown in California, excepting peach, apricot, and the black Tartarian cherry. It attacks the bark of the trunk and limbs as well as the leaves and fruit. I have seen many plum and apple trees upon which all the fruit was so badly infested that it was unmarketable. In other instances I have seen the bark of all the small limbs completely covered by the scales. In such instances the wood beneath the bark is stained red.

In his account he gave the insect the common name of "the pernicious scale," and the name San Jose scale seems to have originated in California, a term to which the citizens of San Jose have always objected.

The insect spread along the Pacific coast rather rapidly and was the occasion of much loss, but for years was confined to that part of the country.

The original home of the species was under dispute for many years. For a time it was thought that it had been introduced by James Lick, from Chile. Years later this was found to be incorrect, and its original home was then attributed to Japan. The question was finally settled by Marlatt, who has shown definitely that its home country is China. Lick imported trees from all parts of the world, and undoubtedly some from China as Marlatt has shown. It seems rather well proved that its occurrence in Chile and Japan was due to importations from the United States after it had been brought here from China.

The species was not known to eastern fruit growers until 1893. In August of that year Doctor Hedges, of Charlottesville, Virginia, discovered some curious spots on his favorite pears and sent them to Doctor Galloway of the Department of Agriculture, thinking that they were a fungus disease of some kind. Doctor Galloway brought them to me, and I jumped from my chair in excitement on recognition of the fact that the San Jose scale was at last in the East. Men were sent at once to Charlottesville, and an effort was made, by the use of oil insecticides, to exterminate the outbreak. In the course of the next few months, however, scales were received from Maryland and Florida; and hence in the spring of 1894 an illustrated warning circular was sent out which resulted in the receipt of specimens from very many localities, and it was found that the dread orchard pest was rather thoroughly established throughout the Eastern States largely from the fact that two firms of nursery dealers in New Jersey had imported infested stock from California; that their nurseries had

become well infested and that the stock which they had sold here and there and everywhere had carried the scourge.

The announcement of these facts aroused the most intense interest among fruit growers everywhere. The entomologists of the different States at once began investigations and experimental work. The sale of nursery stock had become so great an industry during recent years, and the multiplication of this scale insect is so rapid, that, without another introduction of the scale from California, the products of two introductions in the East had in six years been spread through portions of almost every one of the Eastern and Middle States. Not only the economic entomologists, but the agricultural and horticultural societies, the agricultural journals and the State organizations became aroused, and in the next few years the literature relating to this insect became enormous. Within five years its bibliography comprised several hundred titles of permanent record and several thousand articles had appeared in ephemeral publications. It had occupied the attention of nearly every meeting of farmers and fruit-growers that had been held in the Eastern States, from the village clubs to the great State horticultural or agricultural societies. It had been the exciting cause of a national convention of fruit-growers, farmers, entomologists, and nurserymen. It had been the subject of legislation in 16 States of the Union, and its suppression was the principal object of two bills before Congress. Thus the entomologist had become a person of much importance.

But this was not all. On February 5, 1898, the Emperor of Germany issued a decree prohibiting the admission of American fruits and living plants into Germany. A day or so later a shipment of California pears arrived at the port of Hamburg and was refused admittance. The fact was telegraphed to American newspapers and there was much excitement both in horticultural and in official circles. General interest was created by the more or less sensational articles published.

For some days there was no knowledge in this country of the wording of the decree, and beyond the fact that it was understood that the introduction of injurious insects from America was feared, no reason for its promulgation could be assigned. The general impression seemed to be that the decree was issued at the instigation of the agrarian party in Germany and that it was to be considered as a retaliatory measure against the United States for certain tariff legislation by this country. All the early articles published in the United States protested vigorously against the enactment, and insisted that

there was no ground for it, since the danger to Germany from American insect pests was purely imaginary.

Californians were particularly indignant, since it was a shipment of California pears that had been refused. Interviews with Congressional representatives of that State, published in Washington, stated that California especially prided herself on the cleanness of her fruit and upon the vigorous measures which for years she had taken to prevent the introduction of injurious insects within her boundaries. It was reported in the newspapers that vigorous diplomatic correspondence between the two governments ensued and that Ambassador Andrew D. White had been instructed to protest energetically against the edict and to endeavor to secure a modification of its terms.

It was not long, however, before the text of the imperial decree became known, and it was then found that the particular insect aimed at was the San Jose scale. When Ambassador White, at the instruction of Secretary of State Judge Wm. R. Day, called on the Foreign Minister, Von Bülow, in Berlin, the latter sent a clerk for certain documents and handed the American Ambassador a bulletin on the San Jose scale that had been published in 1896 by the Department of Agriculture at Washington and which contained all the facts concerning the destructiveness of the insect and its menace to eastern orchards. (Possibly the fact that Doctor White, who had been President of Cornell University, discovered that the bulletin had been written by one of his own former students may have given an added assurance of its soundness.)

The action of Germany immediately called the attention of other nations to the danger which similarly threatened them. On March 18, 1898, Canada passed a prohibitory law known as the "San Jose Scale Act." A month later the Government of Austria-Hungary issued a decree simultaneously at Vienna and Budapest prohibiting the importation into that country from America of all living plants. Holland and Sweden sent experts to the United States to make a study of the situation.

Thus the San Jose scale was the cause, not only of a very great arousing of interest in entomological matters in the United States, but it promoted international quarantines on a very large scale.

From the action that foreign governments took at this time we may date the beginning of the agitation in this country to provide for our own protection against foreign importations, which, delayed for years largely by the lobbying of the very interests which ought to have been most friendly to its passage, was finally enacted into the Federal horticultural law of 1912.

While the United States has thus perhaps ultimately profited by the whole experience, there is one lesson which she might have gained but which she does not seem to have learned. Germany at that time had an agricultural expert attached to her embassy at Washington. I think that it was Count Beno von Hermann. He was a charming young man, well posted, and a ready talker. I myself handed him in my office one day when he called a copy of the bulletin that brought about all the trouble for the United States and which was afterwards shown to Ambassador White by Foreign Minister Von Bülow. The United States should have had, and should have, men of similar ability in agricultural lines attached definitely as "agricultural attachés" to its principal foreign offices. This was done once, in the case of C. W. Stiles, who was stationed in Berlin for a time when the subject of trichinosis in German meats was under dispute, but it has never become a practice.

At the present time (1927) the San Jose scale is not the terrible orchard pest that in 1898 we feared it would become. This does not mean that the alarm excited among the fruit-growers by the entomologists was in the least unjustified. It does not mean that the scale is controlled by parasites that have become habituated to it. Apparently it does not mean that our fruit-trees have developed qualities resistant to scale damage, although this has been suspected in regions which have harbored the scale for the greatest length of time. It does mean, however, that the entomologists and the orchardists have developed remedial treatment, applied especially during the dormant season, in the way of lime-sulphur and mineral oils, which destroys the overwintering scales and thus prevents serious damage during the following summer. The scale still exists in nearly all orchards, and there is always a reservoir of living material on untreated garden fruit-trees growing along the roadsides or on waste lands. For some unknown reason, such trees, although stunted in their growth and producing very inferior and spotted fruit, continue to live for many years. Possibly, to a slight extent, they have developed resistant qualities.

But the United States grows as much and even more good fruit than it did 30 years ago, although at the cost of greater expenditure (Quaintance has estimated it at 20 millions of dollars each year). Winter washes have become an annual charge against the fruit-growers, and the control of the San Jose scale is simply another instance in which we are still obliged to spend great sums of money in fighting an injurious species while we are still trying to find some easier, cheaper, and more natural means.

I should have stated earlier in this account of this insect, although perhaps it has been inferred, that intense investigation of its biology was begun at once and that it is one of the species that have been most studied by careful workers. When Comstock found it in the Santa Clara Valley of California he called it the pernicious scale. It is in some ways unfortunate that it has come to be known popularly as the San Jose scale. It was suspected for a time that James Lick brought it in from Chile on apple twigs, and at another time that he brought it from Japan. The question as to its origin was eventually settled by Marlatt who studied it in Japan and decided that Japan got it from the United States. He afterwards found it in China under such conditions as to show that its original home was north China. Further than that, he showed that in all probability James Lick imported it, possibly through the missionary, Doctor Nevius, on the flowering Chinese peach. Marlatt, in his wonderfully interesting account of his search for the native home, concludes that the insect should be known as the Chinese scale and that it came to this country on some ornamental stock from north China.

THE COTTON BOLL WEEVIL

Seemingly unimportant things that are later connected with great events are well worth recording. Back in 1843 a Swedish entomologist named and described, in Europe, a little weevil which had been collected by some one in Vera Cruz, Mexico. The entomologist was C. H. Boheman, and he called the weevil *Anthonomus grandis*. In 1871 a German entomologist named E. Suffrian recorded the same insect as occurring in Cuba. That is all that the world knew of this famous insect down to 1880. In the latter year a very interesting man named Dr. Edward Palmer, an Englishman by birth and a professional botanical collector, who had traveled greatly in Mexico for the United States Department of Agriculture and for Harvard University, found that a small, dark-colored weevil was doing great damage to cotton in the neighborhood of Monclova, Mexico. He sent specimens of this weevil to the Department of Agriculture in Washington with the statement that the insect had stopped the cultivation of cotton in that part of Mexico.

When Doctor Palmer's letter and specimens arrived in Washington (the letter was addressed to the then Secretary of Agriculture, W. G. Le Duc), Professor Comstock was in California; E. A. Schwarz, the experienced beetle man was then working with the United States Entomological Commission and not with the Department of Agriculture; and the writer, who knew very little about beetles, and to whom the cor-

respondence was referred since he was in charge of the entomological office, took the specimens to Mr. Henry Ulke, an artist, musician, and famous collector of Coleoptera, who lived in Washington. The insect was new to Ulke, and he sent it to Dr. George H. Horn, of Philadelphia, the foremost American authority on beetles. The insect proved new to Doctor Horn also, and he in turn forwarded it to a well known writer on the weevils, in Paris, Monsieur A. Sallé. Eventually the name came back, and we had at least the satisfaction of knowing the name of the Mexican pest.

No mention was made of this matter in any of the publications of the Department of Agriculture until 1885 when, Professor Riley having returned as chief of the entomological service of this Department, the mere fact was mentioned in his report for that year.

Again some years elapsed; and then the species was brought very forcibly to the attention of the Department. On October 3, 1894, Mr. C. H. DeRyee, of Corpus Christi, Texas, sent the following letter to the Department of Agriculture in Washington:

The "Top" crop of cotton of this section has been very much damaged and in some cases almost entirely destroyed by a peculiar weevil or bug which by some means destroys the squares and small bolls. Our farmers can combat the cotton worm but are at loss to know what to do to overcome this pest. They claim the ordinary methods of poisoning for cotton worm have no effect on these bugs. They probably deposit their eggs in the square and their larvae enter the boll as soon as sufficiently formed and are there out of reach of the poison.

Will you kindly, for the benefit of our farmers, let me know what this pest is and send me any literature that may be available with information which will enlighten and benefit our farming people.

I send you by mail today a lot of these bugs put up in a small vial. Have put some coarsely ground flax seed in with them which may keep them alive till you receive them.

Mr. DeRyee was a member of the firm of DeRyee & Bingham, dealers in drugs and medicines. The exact locality from which the specimens came was not given, but it was obviously not very far from Corpus Christi. The original sendings did not reach Washington, and an additional sending was requested. On October 26, 1894, more were received and were identified as *Anthonomus grandis* by Doctor Schwarz, who had resumed his work in the Department of Agriculture. The situation appeared to be so serious that C. H. Tyler Townsend was sent from the Department, and from November 15 to December 15 traveled in south Texas and adjacent Mexican territory, and submitted an alarming report.

Between the time when Doctor Palmer found the insect at Monclova and the receipt of Mr. DeRyee's letter just quoted, it had begun

to do damage at points farther east, and from Matamoros had crossed the Rio Grande at Brownsville. It must have been in the Brownsville region before 1894, but north of this point there was a large area in which there was no cotton. Evidently, however, cotton had been carried, for ginning, north to Alice, and thus the insect became established in the good cotton region about Alice, San Diego, and Corpus Christi. Mr. Townsend reported that the damage to the crop during 1894 in this latter region amounted to from 75 to 90 per cent. The remedies that he suggested included burning the fields, flooding where this was possible, rotation of crops, picking and burning the bolls, and turning cattle, hogs, etc., into the cotton fields. He especially recommended the abandoning of cotton throughout a wide strip of country along the Texas border. He showed that a fifty-mile non-cotton zone would protect the United States, and gave it as his opinion that crops more valuable by far than cotton could be raised in the territory.

The following year the insect spread further. Mr. Townsend was in the field and was joined by E. A. Schwarz and later by the writer; and by the close of the year the weevil had been found as far north as San Antonio and as far east as Wharton. Texas had become seriously alarmed. The then Governor of the State (Charles A. Culbertson, later for many years United States Senator) visited Washington the following winter. He was an old friend of Dr. C. W. Dabney, at that time Assistant Secretary of Agriculture. The writer was called into consultation, and the Governor was strongly urged to forward legislation by the State of Texas establishing an antipest law and creating a non-cotton zone for the protection of the rest of the State and the rest of the cotton belt—a law, in fact, comparable in many respects to the State pest law of California which was the first State law of this kind to be adopted. The plan met with the Governor's approval, the bill was drafted and presented to the Texas State legislature, but it failed to pass, and it seems safe to say that the responsibility for the enormous loss which followed lies at the door of that particular legislature.

The spread of the insect continued. Mr. Townsend continued his investigations.¹ A State convention was held at Victoria, Texas, and

¹ In April, 1896, Dr. Marlatt, in the course of a general trip of inspection to the Southwest, including California, spent a week studying the boll weevil situation in southern Texas, and, in cooperation with Judge Borden, conducted some tests with arsenical sprays. These tests demonstrated clearly that the early-appearing weevils fed readily on volunteer cotton, piercing the leaves with minute holes, and could be easily killed by an arsenical application. The possibility of thus destroying overwintered weevils on volunteer cotton prior to

was attended by many planters, bankers, and merchants. The legislature of the State passed a bill providing for the appointment of a State Entomologist with a limited appropriation for an investigation.

The United States Department of Agriculture, realizing that the State wished to do this work, stopped its own investigations and referred all correspondence to the new State Entomologist of Texas.

The spread, however, continued, and as it became certain that other States were threatened the Federal Government once more took up the investigation in the spring of 1901. The late W. D. Hunter was appointed to head the work, and continued in charge until his lamented death in October, 1925.

Hunter and his associates, notably Dr. W. E. Hinds (now State Entomologist of Louisiana) and later Dr. W. D. Pierce, built up a strong organization, and very early decided, after a very large-scale field demonstration, that a change of agricultural methods was necessary. They demonstrated that, with the use of an early-maturing variety of cotton and a forcing of the crop, bringing about an early harvest, and the destruction of all cotton standing in the field by the end of October, damage by the weevil could be reduced to the minimum and its spread greatly delayed. Little or no attention, however, was paid to the recommendation. In the main, cotton continued to be planted and harvested in the same old way, and the spread of the insect continued. It crossed into Louisiana in 1903, into Mississippi in 1907, and so on year after year until, in 31 years after the crossing of the Rio Grande, it had invaded practically all of the more than 600,000 square miles included in the so-called cotton belt.

One who has never lived in the South cannot appreciate what this meant. At the time of the weevil's advent, so large a measure of the prosperity of the South depended upon this one crop that its loss practically affected every industry and every individual. As it spread year after year, partial paralysis followed it at first. Mortgages on old plantations were foreclosed; negro labor fled before the weevil's advance; wealthy families were reduced to comparative poverty; banks failed; planters and speculators suicided.

All of these things happened, and happened very many times, but the spread of the weevil seemed as inexorable as fate. Louisiana made a desperate stand against its entrance from Texas, but did not cause

the appearance of the newly planted crop had special significance on account of the belief that the weevils never feed on the leaves and that therefore arsenical applications to the foliage would be valueless. These tests were the basis for the recommendation of poisoning volunteer cotton, the weevil at that time being limited very largely to a region of such volunteer growth.

it more than a temporary delay; and after the Mississippi bottom lands were invaded it became apparent to all thinking and far-sighted men that the situation of the cotton belt was little short of desperate. But the mass of the planters paid little heed to the warnings and advice of the experts. Wise prophets were scouted as alarmists, and very many took the stand that measures should be taken when the weevil should come and not before, apparently feeling that something indefinite would happen to retard or stop the spread and so save them. It is true that a delegation of prominent men from the Carolinas and from Georgia visited the infested regions and the government laboratory in Louisiana at one time and grasped the seriousness of the situation and foresaw the future disastrous results of the do-nothing policy. These men issued advice and warning to the planters of their States. But their prophetic wisdom met with no adequate response, and impoverishment, failure, and suicide marched steadily along with the weevil's progress.

It is true also that, under the urge of the Federal Government and with the support of congressional appropriations, a great campaign was started "to meet the emergency caused by the advent of the boll weevil," and that strenuous efforts were made to start new agricultural industries, to vary the crop, to draw the South from its absolute dependence on a single culture. This movement was the beginning of a wave which has run over the South and laid the groundwork for the rapidly growing activities now to be seen all through that portion of the country.

Nevertheless, history repeated itself again and again. After a few years of weevil, that is to say, a few years of failure and despair, an invaded State or section of a State began to recover hope, to vary its crops and to continue to grow cotton, at a greater cost it is true, but with the spirit of enterprise and fight that carried it once more into a condition of comparative prosperity. Poor cotton lands have been abandoned; better ones have been more intelligently worked, and good crops have been grown in spite of the weevil.

All through this era, and in spite of the discouragement due to apparent lack of appreciation on the part of the public, the entomologists have worked manfully. The original headquarters of the investigation at Victoria, Texas, were early removed to Dallas and later to Tallulah, Louisiana. As the northeastern part of the cotton belt was invaded a substation was established at Florence, South Carolina, where, in cooperation with the State, careful investigations were carried on to decide the variations in the life history of the extremely adaptable

weevil which might have been brought about by its invasion of new and somewhat different territory.

Able minds of trained men were constantly searching for new light, and every suggestion that was made, not only by men familiar with the cotton crop but by ingenious individuals all over the country and in fact in many parts of the world, was tested by the experts. And these experts included not only the men in the Federal service but also the official entomologists of the different States. As to these last men, it may be stated that, although at the beginning of the cotton boll weevil investigation there was hardly a single trained economic entomologist in the South and in fact no educational institution that trained such men, the lack was soon noted, and the southern colleges and universities took up entomology and began to turn out strong and well trained young men.

At the time of present writing (1928), in spite of the enormous loss which has been caused by the weevil, conditions in the South are immeasurably better than they were 25 years ago. It is true that the abolition of the menace of yellow fever and the practical abolition of the hookworm have been tremendous boons, but the boll weevil experience has probably been a blessing in disguise—in a very terrible disguise, but nevertheless a blessing. Appreciation of this fact is slowly coming. In fact, in at least one locality, it was realized a number of years ago, when a statue was erected to the boll weevil by the citizens of Enterprise, Alabama, with the legend "In profound appreciation of the boll weevil and what it has done as the herald of prosperity."

The very competent cotton planter and economist, Mr. Alfred Stone, of Mississippi, in an address before the United States Chamber of Commerce in Cleveland, Ohio, in 1924, advanced the idea that "The boll weevil is not the dominantly controlling factor in cotton production which it is thought and claimed to be by the average man who considers or discusses the subject." He goes on to say that if this were true "it would follow as a logical sequence that the final control of the weevil would mean such an over-supply of American cotton as would glut the markets of the world. If this were true then the control of the weevil would be a calamitous thing for the cotton grower, instead of a benefit, for his product would share the inevitable economic fate of the extreme over-production of any commodity."

As early as 1924, Dr. Clarence Poe, the Editor of the *Progressive Farmer*, summarized nine clearly indicated and logical results of the boll-weevil investigation in addition to the obvious result that the one-

crop system was being done away with and that diversification was being promoted. The nine results discussed by Doctor Poe were as follows:

(1) The boll weevil is speeding up the processes of agricultural evolution in the South.

(2) The boll weevil discourages absentee landlordism, which has been one of the great curses of the South.

(3) The ancient crop-mortgage, "time-prices" system, which has so long cursed the South, has also been hard hit by the coming of the boll weevil.

(4) Agriculture will become more nearly boss of itself (and not the tool of the mercantile interests).

(5) The boll weevil sharply penalizes the traditional indifference to soil fertility which has also been one of the curses of the South.

(6) The boll weevil necessitates higher grade tenants and renters and disperses those who do not come up to the new standards.

(7) We must now have more intelligent labor, even to make cotton profitable, and this opens the way for other lines of farming progress heretofore neglected.

(8) The boll weevil penalizes agricultural indifference and insures agricultural alertness.

(9) Last but not least, the coming of the boll weevil promises to give us on southern farms a greater proportion of men who really love farming. . . . The weevil has greatly intensified the struggle for the "survival of the fittest" and has caused thousands of the unfit to go into other industries and other sections. . . . From now on, cotton growing demands alert intelligence. The boll weevil has speeded up both the passing of the clodhopper and the coming of the up-to-date farmer.

In the great boll weevil investigation two names stand out most prominently among those of many who from time to time have been connected with it, namely W. D. Hunter and B. R. Coad.

W. D. Hunter, of Nebraska, selected for the work in the spring of 1901 on account of the ability he had shown in another investigation, stayed in the cotton states, mainly in Texas, for the rest of his life. Centering around the boll weevil, his work gradually came to cover the whole subject of insects injurious to southern field crops, and later of insects affecting domestic animals and the health of man. He was respected and loved by many of the most prominent people of the South, and no man was ever more sincerely mourned. He combined scientific methods and scientific insight with a broad knowledge of practical affairs to an extent seldom found in an individual.

B. R. Coad came to the laboratory at Victoria, Texas, from the University of Illinois in 1911. In 1915 he was placed in charge of the boll weevil laboratory at Tallulah, Louisiana, and Doctor Hunter gradually turned over to him the entire management of the boll weevil work. Coad developed the process of cotton dusting with calcium arsenate to such a perfection that it became the standard protection of cotton

against the weevil; and later brought about the use of airplanes for the distribution of this poison dust over large areas. Many people think that it has been very largely through his labors, that cotton can be grown profitably in the presence of the weevil. He is now (1928) in charge of all the work on Cotton Insects for the United States Bureau of Entomology.¹

But the work, largely biological, of Hinds and Pierce and of many other assistants must not be forgotten. Possibly no other insect is better known today than is *Anthonomus grandis*.

I first visited the field in 1896, joining Townsend and Schwarz. Again I joined Hunter in the summer of 1901, and for many years thereafter went to the South each year to see the conditions and the work. So vivid were the impressions I gained, so novel were the experiences, so many and so delightful were the new southern friends and so sad was the plight of many of them, that for many years the South, the southern people and the boll weevil were uppermost in my mind. The bravery of the people, the wonderful way they accepted a burden that would in any other region have driven thousands more to despair, was a revelation to me. They actually joked about this small but terrible enemy; cheap cigars were called "boll weevils"; sign-boards said "Forget the boll weevil and come to [such and such a show]"; the boll weevil became a daily and even an hourly word; the man in the street was heard in a fight to call his opponent a blank blank boll weevil—evidently nothing worse, in his opinion, could be said. A politician in the heat of political argument was quite apt to

¹ While I have omitted mention of State officials, a number of whom did excellent work in the course of the investigation of this pest, the name of Wilmon Newell stands out for a very especial reason. Mr. Newell went south in 1902, and was stationed for a time in Texas. In 1903 and most of 1904 he was State Entomologist of Georgia, and in the latter part of the latter year he was made Entomologist of the Louisiana Experiment Station and Secretary and Entomologist of the Louisiana Crop Pest Commission. These posts he held until 1910, when he returned to Texas; and eventually, in 1915, became Plant Commissioner for the State Plant Board of Florida. In 1921 he was made Dean of the College of Agriculture of the University of Florida, Director of the Florida Experiment Station, and Director of the Agricultural Extension Division of the University of Florida. His name stands out among the workers on the cotton boll weevil for the reason that in 1907, in Louisiana, he first tried powdered lead arsenate against the boll weevil. Large field tests followed in 1908 and 1909, and the results showed a decided increase in the yield on the poisoned plots. This was the first use of an arsenate in powder form against the weevil, and undoubtedly led naturally and directly to the development of calcium arsenate by Coad and the subsequent use of that material on such a broad scale throughout the cotton belt.

call his opponent a boll weevil. A prominent official of one State was called "The greatest boll weevil the State of Mississippi ever produced."

Doctor Hunter once told me that the boll weevil had figured in a number of romantic tales, some of them dealing with the villainous introduction of the insect for the purpose of wreaking vengeance on a community. Of course the insect figured often in the newspaper cartoons. One of the best of them appeared in the *News of Greenville, South Carolina* in 1911. It showed a gigantic boll weevil standing partly in Georgia and partly in Alabama, its shadow beginning to strike South Carolina. In its hand it held a black flag with skull and cross-bones, and the legend read "In the shadow of the pest."

And it got into poetry and even into the only folk-song we have in the United States—that of the negro. One of the longest and best of these is a narrative work song recorded by Prof. Gates Thomas, of the Southwestern Texas State Teachers College at San Marcos, in the *Publications of the Texas Folk-Lore Society*, No. 5 (1926), pages 173 to 175. The two stanzas at the end of this song are as follows:

The boll-weevil sez to the farmer, "What make yo' neck so red?"
"Tryin' to beat you devils; it's a wonder I ain't dead;
For you're takin' my home, Babe, just a-takin' my home!"

"Well ef you want to kill us, I'll sho-God tell yo' how:
Just bundle up yo' cotton sack and th'ow away yo' plow;
Then hunt yo' a home, Babe, then hunt yo' a home."

Note that the boll weevil itself makes practically the same recommendation for its own extermination that Townsend made in his original report in the winter of 1894-5 and which was urged upon the Governor of Texas by Assistant Secretary Dabney and the writer.

INSECTS AND DISEASE

The last of the four striking discoveries of the last decade of the last century which have been so instrumental in the promotion of work in applied entomology was the demonstration by Ross in India that certain mosquitoes carry malaria and that only through their punctures do people get malaria. This was one of the most important, far-reaching, and revolutionary discoveries ever made in the etiology of disease.

Although Manson had previously proved the transmission of filariasis by mosquitoes, and although Smith and Kilborn had demonstrated the carriage of the Texas fever of cattle by ticks, the insect

transmission of disease was brought before the people with immense force by Ross' work. Malaria was practically a world-wide malady; millions of people were subject to it; and it is therefore no wonder that the attention of investigators everywhere was drawn to this new field and that by their work the field was broadened out to an extraordinary degree. Almost immediately Ross' results were confirmed in Italy, and antimalaria work from the mosquito standpoint was begun in many parts of the world.

In a very short time the work of Reed, Carroll, and Lazear demonstrated that without a doubt yellow fever is also mosquito-borne and is transferred only by a certain species of mosquito. Medical entomology became at once an important field of investigation. Discoveries followed one another with rapidity. New schools of tropical medicine were founded, and teaching in these subjects was begun in the medical colleges. In the thirty years that have elapsed since Ross' discovery thousands of papers have been published giving the results of research work all over the world, and large and comprehensive books have been published on medical entomology. In fact, the world's output of scientific papers relating to this kind of scientific work has become so great that their titles alone crowd the pages of the bibliographical journals, while at least one journal of this kind has been established solely for the review of this mass of special scientific literature.

So rapidly did discoveries mount in number that as early as 1921 W. D. Pierce, in the large book edited by him and entitled "Sanitary Entomology," devoted 27 pages to the mere listing (in fine print) of the maladies of man and domestic animals that are spread by insects, of their insect transmitters, and of the secondary hosts of these insects where such are involved. The four years and more of the world war, while interrupting scientific investigation to a certain extent, incited work on some of the problems of this nature, and many important facts were discovered and many important results were gained.

It is perfectly true that most of the main discoveries in medical entomology have been made by medical men, but all future work demands the intimate cooperation of pathologists and entomologists. The control of an insect-borne disease, whether of man or of domestic animals, means primarily the control of the carrier; and who so competent to investigate the possibilities in that direction as the man trained in economic entomology? Down to the present time perhaps the entomologists have realized this more than the medical men have done. It has happened too often that medical investigators have

underestimated the need of colleagues trained in entomology. They have underestimated the difficulties of entomological study. What has appeared simple to them has been shown often to be extremely complex. But the old ideas are passing away, and the vital need of cooperation in this as in so many other directions is apparent.

The great French parasitologist, Raphaël Blanchard, once said—

The rapid movement which leads medicine into the current of parasitology cannot be stopped. In reality these two branches of general biology seem more or less distinct, but, as two rivers whose waters meet and flow side by side for a certain distance soon come together, so parasitology may include almost the entire domain of medicine. (Translated.)

This may be the extreme view of an over-enthusiastic parasitologist, but it cannot fail to emphasize the importance of the study of the insect carriers of parasitic diseases.

A rather full chapter on medical entomology will be found near the end of this book.

QUARANTINE AGAINST INJURIOUS INSECTS

Although the United States has been one of the very greatest sufferers from damage by pests imported accidentally through commerce, it was one of the latest countries to adopt satisfactory quarantine measures. This was due to some extent to ignorance and inertia, but later to the active opposition of organizations of people engaged in some one branch of the importing business.

The Phylloxera scare, beginning in Europe in 1859 and going around the world subsequent to 1869, induced the first legislation of this kind in other countries. Legislation against the Colorado potato beetle was adopted a few years later. Of all the States in the Union, California was the first to take action to stop the incoming of plant pests; and her first law, passed in 1881, was broad and at the same time specific, and, with subsequent modifications, has proved reasonably effective. Other States were repeatedly urged to pass similar laws, relating, however, for the most part to commerce between States in the Union; and eventually certain other States followed the example of California. As early as January, 1895, I brought these laws together in Bulletin 33, old series, of the Division of Entomology, and there were at that time in operation State laws of Oregon, Washington, Idaho, New Jersey, Colorado, Missouri, Kansas, Minnesota, and Nebraska. Other States followed, and in Bulletin 13, new series, published three years later (1898) all of these laws were brought together.

In an address entitled "Injurious Insects and Commerce," delivered before the Peninsula Horticultural Society at Dover, Delaware, January 11, 1895,¹ I made a plea for the extension of such legislation, terming it "The Crying Need of the Present Time," pointing out especially the unprotected Mexican border and stating that work had been begun by the Federal Department of Agriculture to study the possibilities of imported pests from Mexico. The following year (February 15, 1896) I gave an address before the Massachusetts Horticultural Society, urging the adoption of general legislation.

Carrying the idea further, I prepared in 1897 a rather lengthy article entitled "Danger of Importing Insect Pests," which was published in the Yearbook of the Department of Agriculture for that year, accompanied by illustrations of a number of the dangerous insect pests of foreign countries that at any time, through commerce, were possible assisted immigrants.

During 1896 I had been corresponding with F. M. Webster, then Entomologist of the Ohio Experiment Station at Wooster, Ohio, who induced the Ohio State Horticultural Society to adopt resolutions calling for a "national convention for the suppression of insect pests and plant diseases by legislation." This convention was held March 5 and 6, 1897, at Washington. It was attended by representatives of State agricultural and horticultural societies, State granges, agricultural colleges and experiment stations, and experts from the United States Department of Agriculture. At this convention four papers were read—one by myself, entitled "The Desirability of an Inspection System against Foreign Insects"; another by Dr. B. T. Galloway, of the Department of Agriculture, entitled "Plant Diseases and the Possibility of Lessening their Spread by Legislation"; a third by B. F. Lelong, of California, entitled "The Inspection of Trees, Plants, Fruits, etc., as Conducted under the Laws in California"; and a fourth by Gerald McCarthy, of North Carolina, entitled "Crop Pests and Their Repression by Law." At this convention a bill was drafted and discussed. I had a stenographic report made of the discussion, which was printed in the proceedings of the convention which were published as a special unnumbered bulletin by the Department of Agriculture. In the discussion, the nurserymen, led by W. C. Barry, voiced several objections to the bill submitted. This was the first indication of the opposition to such legislation from the nurserymen and this opposition accumulated force from that time on for a number of years.

¹ *Insect Life*, vol. 6, pp. 332-338, March, 1895

On the 5th of February, 1898, Germany suddenly placed an embargo on the importation of all American fruits and fruit plants. Germany was followed by nearly every European country; and other countries of the world followed suit. There was great consternation in official circles in Washington when Germany's action became known. President McKinley called in his Secretary of State, Judge Wm. R. Day, and they puzzled about the reasons. Had it been done in retaliation for the action of the American government in regard to trichinized pork from Germany? At all events, they decided it must be looked into at once, and the Secretary of State cabled to Ambassador Andrew D. White at Berlin to find out the cause of the apparently unfriendly action on the part of the German government. Ambassador White called on the German Minister of Foreign Affairs, Von Bülow, who smiled and sent for a pamphlet which proved to be a bulletin on the San Jose scale that had just been published in Washington and of which a copy had been transmitted to Berlin by the Scientific Attaché of the German Embassy in Washington. Ambassador White cabled back to the Secretary of State; and the Secretary of Agriculture, James Wilson, was immediately brought into the discussion.

Not only did this action on the part of foreign governments emphasize tremendously the importance of action for self-protection on the part of the American government, but incidentally it called attention to the importance of the policy of establishing scientific attachés at foreign capitals.¹

I remember an attempt to draft a satisfactory bill modifying the bill drawn up by the convention of March 5, 1897, which was made by the Hon. Gilbert N. Haugen and myself at his rooms in the old St. James Hotel. Mr. A. E. Ingram (later of the Consular Service but at that time a stenographer in the Bureau of Entomology) acted as assistant. This was the bill, I think, covering both interstate commerce in domestic stock and the protection of entry of foreign stock that was introduced by Mr. Wadsworth, then Chairman of the Agricultural Committee of the House, December 4, 1899 (H. R. 96), and on February 12, 1900, was reported to the House by Mr. Haugen with amendments from the committee.

This bill thereafter was reintroduced at different sessions of Congress. It led a precarious existence. The opposition of importing nurserymen and the interstate factors involved prevented it from going far. It never reached an advanced stage. In the meantime

¹ This latter point had already been urged by Secretary Wilson in his report to the President of the United States in 1892.

numerous conferences were held by entomologists and the Legislative Committee of the National Association of Nurserymen, without any agreement as to suitable legislation. Finally in 1908 the promoters of this legislation became thoroughly discouraged, and the project was definitely abandoned in this shape, since, the San Jose scale having in the meantime been carried on nursery stock into practically every State in the Union, the original reason for the predominating interstate features of the bill had been largely eliminated. I remember well the hearings before the Committee on Agriculture of the House in the winter of 1908-1909 and my complete discouragement as to the possibility of securing the needed legislation.

Fortunately, there was a man who did not allow himself to be discouraged, and that was Dr. C. L. Marlatt, later Chairman of the Federal Horticultural Board and now also Chief of the Bureau of Entomology.

As it happened, the fruit stock that came in from Europe, particularly from France, in 1908 and 1909 carried very many over-wintering nests of the brown-tail moth and many egg-masses of the gipsy moth. These sendings were consigned in very many cases to regions of the United States that had not yet been reached by either of these pests. We were all very greatly alarmed about the matter. At that time, as already stated, many of the States had passed quarantine and inspection laws, and these shipments were held up at many places, and the findings were reported by State inspectors. Doctor Marlatt became intensely interested, and began in 1909 vigorously to prosecute once more the question of national legislation. He drafted a new bill for Congress on a plan that differed greatly from the earlier ones, since it related solely to the safeguarding of plant importations and to the control of important new pests having limited foothold in the United States, abandoning altogether the question of Federal control of interstate traffic in nursery stock that had been carried in the earlier bills. This bill, with the authority of Secretary Wilson, was submitted by Doctor Marlatt to the House Committee on Agriculture. It was introduced by Mr. Scott, the Chairman of that committee, on January 29, 1909, and promptly passed the House. Learning of this, the Legislative Committee of the National Association of Nurserymen came to Washington and asked permission to study the bill and possibly to suggest amendments in minor features. The bill was then withdrawn for this purpose, with Mr. Scott's full consent. Having secured this withdrawal of the bill, the nurserymen opposed any legislation, and during the three and a half years following were

able to prevent the enactment of any law having this general effect. Doctor Marlatt has on file many different drafts and reproductions of the plant quarantine act, which was several times wholly rewritten, and notably after its first disastrous failure March 2, 1911, when it came up for a vote by the House. The legislation was strongly criticised at the time of the vote by several influential Congressmen, notably by Messrs. Mann, Rucker, and Lever.

Doctor Marlatt did not, however, allow himself to be discouraged, and, believing that the opposition of such men must be based on lack of information as to the purpose and necessity for the legislation, immediately sought and obtained interviews with the Congressmen named, and without much difficulty brought them into alignment back of the bill and secured their support. Through them also he secured the support of Speaker Cannon and others; and the Plant Quarantine Act of August 20, 1912, passed. Mr. Mann became particularly interested, aided very materially in redrafting the bill, and was its warm friend and supporter during the remainder of his life.

By the spring of 1912 I was convinced that no immediate relief was to be expected from Congress, and went to Europe partly for the purpose of trying to secure the establishment in France, England, Germany, and Holland (our principal sources of living plants) of thoroughly competent inspection services to assure the cleanness from insects and disease of plants exported to the United States. It seemed to me then that this was our last hope. I visited the ministries of agriculture in each of these countries, and, in spite of my doubts concerning legislation by this country, I predicted to these foreign ministries an eventual embargo on all their plant shipments to the United States in case they did not at once bring about a thoroughly competent inspection over there that would stand the test. Although the French laws were already fairly good, and although their inspection service was supposed to be in charge of a perfectly competent man, I made an address before the Academy of Agriculture of France and received the assurance that they would at once memorialize the Ministry. In fact, I was promised by the authorities of France, Belgium, and Holland that their inspection staffs would be strengthened immediately. After all this had been done, I received a cablegram from Secretary Wilson in August to the effect that the bill had passed. Thus my efforts in the summer of 1912 were in large part wasted.

I remember that in one of the committee hearings in 1908, the Chairman of the Legislative Committee of the National Nurserymen's Association remarked that he did not fear a bill that would be liberally interpreted and in which the interests of the importers would

be carefully guarded, but he did fear that it might be administered in a very strict manner by such a keen person as Doctor Marlatt (and he mentioned him by name). The latter replied that he would not accept such a thankless and difficult position.

However, when the bill did pass in 1912, Doctor Marlatt was induced to accept the chairmanship of the Board which he held with very great efficiency and tact until the close of 1929.

It is an interesting and somewhat sad commentary on the delay in securing this legislation that during the interval of four years between the original introduction of the bill and its final passage in 1912 no less than seven important pests, many of which are now the subject of very considerable State and Federal appropriations, entered this country and became established—such pests, for example, as the European corn borer, the Japanese and related Asiatic beetles, the oriental fruit moth, and the Citrus canker.

The energetic enforcement of the provisions of the Act of 1912, brought about by Doctor Marlatt's intelligent energy, aided by Congressional appropriations, has been undoubtedly of the greatest value to the United States.

In looking over some old papers, I have found some notes of a lecture that I gave in the spring of 1912 before the Brooklyn Institute and before the Staten Island Academy of Sciences. I talked in this way several times during the winter of 1911-12. In order to convey an impression of the way we felt at that time and to give an idea of the efforts we were making, I think that it will be interesting to quote from those notes:

In most if not all European governments many laws are made in the form of decrees issued by the ruler or by his council or by the ministry, and these may or may not be subject to ratification by the parliament or house of delegates.

In the United States, even in case of emergency, a bill must be carefully drafted and must pass both the House of Representatives and the Senate of the United States at a session always crowded with business and by Members and Senators dependent for their places upon men representing many opposing business interests.

Partly for this reason and partly for others, the United States is the only important agricultural country in the world today which does not have a national quarantine and inspection law governing the introduction of plants and preventing the introduction of injurious insects and plant diseases. This country today is the dumping-ground for plants which could not be sold in any other market in the world, while the rest of the horticultural world is quarantined against us.

This was followed by an account of the European legislation against the *Phylloxera*, the German decrees against American pork, the sending of Doctor Stiles to Germany to investigate the alleged

presence of trichinae in inspected American meats, and the German decree in 1898 against the importation of American fruits. I then went on to tell of the efforts that had been made on the part of the people most vitally interested and on the part of the officials of the Department of Agriculture at Washington to secure the passage of protective legislation for the United States; and concluded with the following remarks:

Never before in the history of the Republic has the urgency of such a law been so great. We are menaced on all sides not only by unknown dangers but by a number which are thoroughly well understood.

The Mediterranean fruit fly, an insect which destroys practically all kinds of fruit, filling them with its disgusting maggots and causing them to drop and to decay, has made its appearance in Hawaii, and every bit of fruit landing on our Pacific coast from the Island of Oahu is quite likely to contain this insect in one stage or another, and in the absence of quarantine its establishment in this country sooner or later is a certainty. With the knowledge of what this insect has done in Western Australia, in South Africa and on the Island of Oahu, it is obvious that no worse calamity could befall the fruit-growing industry of this country than the introduction of this pest. A prompt quarantine on all Hawaiian fruit is the only thing that can save us.

But we are confronting an equally dire emergency on the other side. Last year the potato crop of the country as a whole was a failure, and we are now importing potatoes from all available sources; potato growers are importing seed potatoes from Europe, and they are coming in every day without inspection and without reference to the prevalence of disease in the regions from which they are sent to us. It so happens that in many parts of Europe there exists at the present time one of the most serious of all known diseases of the potato; it converts a tuber into an ugly, irregular and utterly unsalable growth. When established in a field it may affect the entire crop and the land remains so infected that potatoes cannot be successfully grown for six or more years. The disease is known as the "wart disease," "black scab," "the canker," and "the cauliflower," and is caused by a fungus. It occurs at present in Scotland, Wales, Germany and Hungary. It has already crossed the Atlantic and has become prevalent in Newfoundland; our neighbor, Canada, has quarantined against Newfoundland potatoes, but Newfoundland can send her potatoes to the United States without let or hindrance. There should be in this country a rigorous quarantine at this moment against potatoes from Newfoundland, Scotland, Wales, Germany and Hungary.

Botanists have known for some time of a dangerous European disease of the white pine, which also affects other five-needle pines and occurs on wild and cultivated currants and gooseberries. This disease has been imported into America at several places, but by active cooperation among the persons interested all cases found have been eradicated. This disease is known as the "blister rust" and its effect upon pines is disastrous; the fungus is sure to kill a tree if the attack is on the stem, and most of the young trees attacked on the stem die the first season. Its introduction into our valuable pine forests would be a national calamity, yet nurserymen may bring pine trees at their will from the worst infested regions of Europe. Moreover, even a patriotic and honest American importer of nursery stock is easily deceived by the dishonest European

importer, and blister rust has been found in this country on pines shipped from a healthy region in France, and later I was told by the exporter himself that he had purchased this stock near the infested district in Germany. A quarantine against all European pines is needed.

At present those scourges of the forests and orchards, the gipsy moth and the brown-tail moth, are confined to New England, but every year nursery stock containing the winter nests of the brown-tail moth and the egg-masses of the gipsy moth enters the port of New York from Europe and is scattered over the country. There is no law which can bring about the inspection of this stock; but by the cooperation of many people an inspection is generally secured even in the absence of the law; it is the best we can do. The Bureau of Entomology at Washington is notified by the Collector of the Port of New York and of other ports upon the arrival of plants from abroad, and is furnished with the name and address of the consignee. Several of the large importing agents in New York send the addresses of the ultimate consignees to the Bureau; several of the railroads also send word of the carriage of foreign plants. In this way, in the great majority of cases, perhaps nearly in all, the Bureau learns the addresses of the persons receiving the plants, and is enabled, either through inspectors of the different states or through its own inspectors, to inspect the plants before they are put in the ground and to advise concerning the destruction of those found to be infested with new pests. It may happen, however, at any time that the gipsy moth and the brown-tail moth and other forest and orchard pests of Europe may escape this kind of inspection, through faulty notification, and may establish themselves here, there, or anywhere in the United States; and when we think of the havoc that these two insects have made in New England and of the enormous sums of money which have been spent to hold them in check, the prospect that other States will have similar fights on their hands is appalling.

It is safe to say that of insects alone, and not considering diseases of plants, the species accidentally imported into this country are costing us some hundreds of millions of dollars annually. It is also safe to say that if the nation does not secure a quarantine and inspection law this amount will be doubled by the losses caused by new introductions.

That this estimate is moderate is shown when we consider only the pests recently introduced and established, that is within the past year or so. Possibly the most destructive of these is the alfalfa leaf weevil, which has already caused enormous damage in Utah and which has spread over into the Wyoming fields and threatens to spread throughout the great alfalfa-growing region of the middle west. The introduction and spread of this insect is a veritable calamity, so much depends upon the alfalfa crops in those regions.

Dr. John B. Smith, of New Jersey, has recently called attention to the discovery of the European red-tail moth in New Jersey. This is capable of being a very troublesome pest, and is a general feeder in Europe, sometimes entirely defoliating forest areas.

In Cambridge, Massachusetts, it has recently been found that the smaller European elm bark beetle has become established, and, working with the leopard moth—also a European importation—has nearly destroyed the magnificent elms in and around the campus of Harvard University. These old trees are being uprooted, and the cost of their removal alone amounts to \$30 per tree.

What bids fair to be a very important apple pest is the apple seed chalcis which has been found in New York State. It is a well-known European pest,

and probably came to this county with apple seeds imported from France. It has spread in destructive numbers in orchards in Pennsylvania.

A destructive scale-insect known as *Pulvinaria psidii* has recently appeared in Florida and has been widely distributed on nursery stock by one of the leading firms of that State.

The mango seed weevil has come in very commonly in mango seeds imported for planting the past year. A warning circular has been issued on this insect, and it is to be hoped that it has not escaped in Florida.

And now a word as to the other pests that are coming in almost daily. Extreme care is taken in the importations of the Department of Agriculture. All such material coming to Washington is thoroughly inspected by officers of the Bureau of Entomology, and, as illustrating what may be brought in by such material, and which in the case of private importers must often escape detection, it may be noted that more than 20 different pests have been intercepted on the importations by the Department, many of them new to this country and with very great possibilities for damage.

FAKE INSECTICIDES AND INSECTICIDE LEGISLATION

It is probable that the condition of affairs with regard to fake or charlatanistic remedies for insects in this country during the last century was no worse than it was in other countries, but it was very bad. There was no governmental control of the sale of compounds for which the most absurd claims were made; and towards the close of the century even such standard insecticides as Paris green were adulterated and sold as pure and effective. If one runs through the old files of the agricultural and horticultural journals it is easy to find advertisements of mixtures for which the most absurd claims are made. There is a queer quirk in the human mind which accounts for the success of fakers. Thousands upon thousands of dollars go into the pockets of these persons daily in many ways and on account of many claims. The public is swindled with most incredible ease, and in the old days fruit-growers and farmers seemed to be especially easy to fool.

No one in the United States wrote about these matters so frequently and so forcibly as Benjamin D. Walsh. The two volumes of *The Practical Entomologist* published in 1865 to 1867 contained many vigorous articles from his pen showing up the absurdity of many remedies which were advocated in the agricultural press. He did not mince words. Some of his articles appeared under the following headings: "Popular Remedies for Noxious Insects," "Doctors Differ," "A New Humbug," "Another Humbug," "Universal Remedies," "Entomology Indeed Run Mad," "Doctoring Fruit-Trees Again," "Another Universal Remedy," "A Mass of Mistakes," "More Universal Remedies," "Quacks and Physicians."

Walsh's fearlessness and his trenchant style were admirable. No one has expressed himself in print about these matters quite as positively as he did. Here are some quotations:

Addressing the advertiser of a patent remedy, he says, "We fear greatly that, instead of being a decently good entomologist, tolerably well acquainted with the noxious insects of the United States, you are a mere entomological *quack*; and that, instead of talking good, common, horse sense to us, you are uttering all the time nothing but *bosh*."

Another time, writing of people of that class and the avidity with which farmers and fruit-growers bought their wares, he says, "Long live King Humbug! He still feeds fools on flapdoodle, and many of them have large and flourishing families who will perpetuate the breed to the remotest generation."

In another connection, referring to the sudden springing of an old scientific name on a generation that commonly uses a later one, he says (and we quote it to show his style), "To my mind the naturalist who rakes out of the dust of old libraries some long-forgotten name and demands that it shall take the place of a name of universal acceptance, ought to be indicted before the High Court of Science as a public nuisance, and on conviction sent to a Scientific Penitentiary and fed there for the whole remaining term of his scientific life upon a diet of chinch bugs and formic acid."

I have made a slight search for some of the old advertisements of those days, but have not found any which it is worth while to reproduce. Reputable journals did not often print them as they did the advertisements of patent medicines, but the most extraordinary circulars were mailed to farmers and fruit-growers, and the country merchants permitted the posting of placards and engaged to some extent in the sale of these untried nostrums.

Thanks to sound legislation in this country the situation is now greatly improved, but there is still a tendency to push the sale of compounds of unproved worth, and there is an amazing readiness on the part of the agricultural public to buy almost anything that is offered. This probably is human nature.

In my frequent journeys to European countries I have found that conditions in this direction in many of those countries are much like they used to be in the United States. There does not seem to be government control over the sale of worthless nostrums.

In 1903 only six States of the United States had passed insecticide laws—California, Louisiana, New York, Oregon, Texas, and Washington. The first State law was probably enacted in Louisiana, but it

related only to Paris green and to the percentage of arsenic contained in this substance as sold—established as a standard that there should be a content of fifty per cent arsenic (probably meaning white arsenic— As_2O_3). In 1898 New York passed a law to prevent fraud in the sale of Paris green. In 1899 Oregon and Texas passed insecticide laws or combined insecticide and fungicide laws. The Oregon law named specifically Paris green, arsenic, London purple, sulphur, "or any spray material or compound for spraying purposes, in quantities exceeding one pound." It required a certificate guaranteeing the quality and per cent of purity of the materials. It provided also a fine for the violation of the act. The Texas law was passed in 1899 and was entitled "An Act for the better protection of the farmer in the purchase of commercial fertilizers and commercial poisons used for destroying bollworms and other pests."

The history of the Federal legislation has been described competently by Dr J. K. Haywood of the Bureau of Chemistry of the United States Department of Agriculture in his address as President of the Association of Official Agricultural Chemists in 1920. It is published in the *Journal of that Association*, Volume 4, No. 1, August 15, 1920. Doctor Haywood, in this address, gives the credit of suggesting Federal legislation on this subject to the Association of Economic Entomologists and more especially to Prof. E. D. Sanderson, then Director of the New Hampshire Agricultural Experiment Station. The Association of Economic Entomologists had a standing committee on proprietary insecticides, and Professor Sanderson was chairman of this committee. The Association instructed this committee to investigate the possibility of securing an interpretation of the Federal Food and Drugs Act which would bring proprietary insecticides and fungicides within its scope, and, should this not be possible, to consider the feasibility of securing an amendment to the law so that proprietary insecticides and fungicides would be covered. It was the opinion of Dr. H. W. Wiley, Chief of the Bureau of Chemistry, after consulting legal opinion, that the Food and Drugs Act did not cover insecticides, and he reported that there should be a special insecticide law. The committee of entomologists requested Doctor Wiley to formulate a Federal insecticide law, and the task was assigned by Doctor Wiley to Doctor Haywood. In his draft, the law applied only to insecticides. It provided in certain cases larger fines than are provided for in the law which eventually passed Congress. It directed that the Act be enforced by the Bureau of Chemistry. It defined "original unbroken package." It stated that the amount of arsenious oxid in Paris green must be 55 per cent. It stated that arsenic in water-

soluble forms in lead arsenate must not be equivalent to more than one per cent of arsenic oxid. It did not allow the addition of water to lead arsenate under certain restrictions. And it did not declare a product adulterated if it contained substances injurious to vegetation.

At the suggestion of Professor Sanderson, the law was rewritten to cover fungicides, and later a section was added to prevent the sale of insecticides or fungicides that would injure vegetation.

The law as finally corrected, with the exception of the clause relative to injuring vegetation, was introduced in the Senate of the United States on April 6, 1908, and while the bill was being considered the entomologists, the agricultural chemists, and various manufacturers met for consultation concerning the provisions of the bill. In its final form it was passed in April, 1910, and became effective on and after the first day of January, 1911.

The most important features of the Act are as follows:

(a) Definite standards for lead arsenates and Paris greens are stated, and it is required that all lead arsenates and Paris greens subject to the act shall conform to these rigid specifications.

(b) All insecticides and fungicides (other than lead arsenates and Paris greens) which contain inert ingredients shall bear a statement upon the face of the principal label of each and every package giving the name and percentage amount of each and every inert ingredient contained therein and the fact that it is inert, or, in lieu of this, a statement of the name and percentage amount of each and every active ingredient which has insecticidal or fungicidal properties, together with the total percentage of inert ingredients.

(c) For insecticides (other than lead arsenates and Paris greens) and for fungicides which contain arsenic or compounds of this metal, a statement must be made on the face of the principal label of the total arsenic, expressed as per cent of metallic arsenic, and total arsenic in water-soluble forms, similarly expressed.

(d) No statement, design, or device appearing on the label of an insecticide, fungicide, Paris green or lead arsenate shall be false or misleading in any particular. It will at once be seen that all false or exaggerated claims relative to the efficacy of the article constitute misbranding, and the Government is empowered to institute criminal or seizure proceedings as outlined above.

(e) All insecticides and fungicides (other than lead arsenates and Paris greens) must be up to the standard under which they are sold.

(f) No substance or substances shall be contained in any insecticide or fungicide (other than lead arsenates and Paris greens) which shall be injurious to the vegetation on which such articles are intended to be used.

There are various other requirements, and, in the words of Doctor Haywood, "It is by a strict enforcement of these provisions specifically mentioned that the consumer is largely protected against those products which bear misleading claims, which are absolute fakes, and which, while killing insects and fungi, may be injurious to the vegetation on which they are intended to be used."

The law is enforced by a board of four members: a representative from the Bureau of Chemistry, one from the Bureau of Plant Industry, one from the Bureau of Entomology (Dr. A. L. Quaintance), and one from the Bureau of Animal Industry.

Down to June 30, 1927, the Federal Insecticide Board, operating under the law just discussed, was an independent board under the Secretary of Agriculture, the representative from the Bureau of Chemistry, Dr. J. K. Haywood, being the Chairman. Working under his direction, there were employed in the Bureau of Chemistry chemists, bacteriologists, and microscopists who made examinations of insecticides, fungicides, and disinfectants, publishing the results in some instances only. The entomologists and plant pathologists of the Board made investigations to determine whether the ingredients of insecticides and fungicides were active or inert against various insects and plant diseases and also whether these substances were injurious to vegetation. Under the appropriation bill for the fiscal year ending June 30, 1928, there was a marked reorganization of some of the branches of departmental work, and the administration of the Insecticide and Fungicide Law was placed definitely under the Bureau of Chemistry and Soils, the old Bureau of Soils having thus been combined with the former Bureau of Chemistry. The law, however, operates as before, with this alteration only.

Since the passage of the act of 1910, many States have passed independent laws. At the time of Doctor Haywood's presidential address in 1920, 21 States had passed such laws which were then in force.

The operation of the law has been highly beneficial. Inspectors of the Board have traveled throughout the United States on carefully prepared itineraries, collecting samples of insecticides and fungicides for examination and test to determine whether or not they are in violation of the act. These samples are sent to the Board at Washington, under seal and with complete records identifying the sample with a specific interstate shipment since the penalties provided by the act refer, so far as the Federal Government is concerned, only to interstate shipments. These samples are assigned by the Board to one or more of the four groups that are engaged in the enforcement of the act. If any samples are found to violate the provisions of the law, appropriate charges are prepared and submitted to the Board. If violation is shown, the manufacturer is cited to a hearing and given a chance to show any error in the findings of the Board. If he succeeds in showing that there has been no violation of the law, the case is placed in abeyance. If the violation is shown not to have

been flagrant, the manufacturer is given an opportunity to correct his labels, without resort to the courts. Eventually the Board considers the matter again, and, if prosecution is decided upon, the Solicitor of the Department of Agriculture is consulted and given the recommendation of the Board. The Solicitor then decides, from the legal point of view, whether or not in his opinion the law has been violated. If it has been violated, the Secretary of Agriculture is appealed to for action. If he agrees with the Board and the Solicitor, the Department of Justice is called in and the case is referred to the proper United States attorney for prosecution.

Reports of decisions are published from time to time, and the result has been that the public has been protected to a very marked degree and an enormous amount of swindling has been prevented. Without doubt the passage of this act and its subsequent successful administration has been a great step in the fight against insects. It has been an object-lesson to other nations.

At the beginning of the fiscal year 1928 the Department brought together into one unit, known as the Food, Drug, and Insecticide Administration, a number of regulatory activities as indicated by the title. With this reorganization the Insecticide and Fungicide Board, which had operated since the passage of the act of 1910, ceased to function; and this new regulatory administration added to its force the entomologists and pathologists previously working under the direction of the Bureau of Entomology and the Bureau of Plant Industry. These experts, however, as under the old Insecticide Board, devote their attention exclusively to the securing of information concerning proprietary insecticides, fungicides, and disinfectants, that will be of use in the enforcement of the act.

ECONOMIC ENTOMOLOGY IN THE SOUTHERN UNITED STATES

Climate, occasional outbreaks of yellow fever, the prevalence of the hookworm, and later the Civil War combined to keep the Southern States behind the front line of progress. The result has been, with economic entomology, that there were no trained workers born and educated in the South until a very recent date.

There were some early writers who published good things, such as Colonel Edmund Ruffin who wrote on the Angoumois grain moth, and Thomas Affleck, Dr. D. B. Gorham, Dr. D. L. Phares, Dr. E. H. Anderson, Judge W. J. Jones, Prof. J. E. Willet, and Prof. J. P. Stelle, all of whom wrote at some length, principally about the cotton caterpillar. Then there were at least three northerners who went

south for some years, who were trained scientific men and who wrote about insects. These were Dr. W. I. Burnett, Major J. L. LeConte, and Dr. A. R. Grote.

Even 25 years ago there were no native southern entomologists, and there was no competent instruction given in entomology in any southern institution. I remember in the early days of the cotton boll weevil investigation, when I was discussing appropriations with the Committee on Agriculture of the House of Representatives, one of the southern members of the committee said to me "Who is this man Hunter; where does he come from?" I replied, "From Nebraska." "And who is Hinds?" was the next question, "Where does he come from?" My reply was "Massachusetts." "Well," said the Member of Congress, "I should think that you would have sufficient judgment to employ for a job of this kind southern boys who know the cotton crop and who know the people." My reply was that the South at that time was not educating men in this line, and I went on to say that Mr. Jefferson Johnson, then Commissioner of Agriculture of Texas, had told me only a few weeks before, at Austin, that he considered W. D. Hunter of the Bureau's force the best posted man he knew on all aspects of the cotton crop.

It was at this same hearing that I took with me an enlarged papier-maché model of the cotton boll weevil, perhaps 14 inches long. When Mr. Wadsworth, the chairman of the committee, called on me, I took this model from its case and placed it on the table before me: upon which Captain John Lamb, of Virginia, a member of the committee, sang out to Congressman Burleson of Texas, who was also a member of the committee and afterwards Postmaster General under President Wilson, "My God! Burleson, is it as big as that?"

It is probably not realized that practically all of the men who have become prominent in entomological work in the Southern States during the last 25 years (this is written at the close of 1927) have been of northern birth and northern education. Let us take a dozen of them. Wilmon Newell, of Texas, Louisiana, and Florida, was born in Iowa and educated at the Iowa State College of Agriculture. W. E. Hinds, of Texas, Georgia, and now of Louisiana, was born and educated in Massachusetts (Massachusetts Agricultural College). Franklin Sherman, of North Carolina and South Carolina, although born in Virginia, was educated at Cornell University. A. F. Conradi, formerly of South Carolina, was born and educated in Ohio (Ohio State University). Harrison Garman, for many years Entomologist of Kentucky, was born in Illinois and educated at Johns

Hopkins. J. H. Morgan, for many years an authoritative worker in Louisiana, and now President of the State University of Tennessee, was born in Ontario, educated at Guelph and Toronto. E. N. Cory, for many years Entomologist of Maryland, although born in New York, was educated at the Maryland Agricultural College. R. W. Harned, the efficient Entomologist of Mississippi, although born in Maryland was educated at the Ohio State University and at Cornell. W. D. Hunter, who lived during practically the whole of his productive life in Texas and was very highly esteemed by the cotton planters and other prominent men of that State, was born and educated in Nebraska. G. M. Bentley, the Entomologist of Tennessee, was born in Massachusetts and educated at Cornell. E. W. Berger, the Entomologist of the Florida Experiment Station, a well known worker, was born in Ohio and educated in Ohio colleges and at Johns Hopkins. E. L. Worsham, the twelfth on our list, is the only one who was born in the far south, namely in Georgia, and was educated at the Georgia State University and at Cornell.

The South, however, is rapidly coming into her own in all ways, including economic entomology. Sound courses in applied entomology are being given in all the southern State colleges, and young men are being graduated who are well fitted to produce good results.

I had written down to this point in December, 1927. At the end of the year the annual meeting of the American Association of Economic Entomologists was held at Nashville, Tennessee, in conjunction with the annual meeting of the American Association for the Advancement of Science. The annual address to the Economic Entomologists was given by the retiring President, Prof. R. W. Harned of the University of Mississippi. He had chosen for his subject "Entomology in the Southern States," and when published the address was found to cover 25 pages of the February, 1928, number of the *Journal of Economic Entomology*. This very full paper covers the ground about which I have written above and introduces very many significant statements. Professor Harned, with an intimate knowledge of the conditions that exist in the Southern States today, evidently spent much time and much thought upon this paper and brought out many points of importance. He showed, for example, that the South is today in reality one of the most active sections of the country in entomological work. Based upon figures of one million white population, he shows that, of the members of the two great national entomological societies, namely the Entomological Society of America and the American Association of Economic Entomologists, the State of Mississippi leads (after the District of Columbia); that

Florida is third, and Louisiana fourth, these three Southern States exceeding the old entomological centers of Pennsylvania, New York, Ohio, Illinois, and the New England States. Incidentally, his tabulation indicates that California comes sixth, and that Utah, Oregon, Idaho, and Wyoming take the eighth, ninth and tenth places, immediately preceding Massachusetts. He has tabulated the amounts spent on entomological research in the South and shows that more than \$105,000 is being spent annually in this way by the 11 southern experiment stations which employ for this purpose 50 men. He incidentally shows that the Federal Government is spending \$392,000 on full-time projects in the South, employing 73 workers, and that further the Federal Government is spending parts of a sum amounting to \$166,000 upon projects which are being investigated in the South as well as at northern and western stations. He further shows that, while the Southern States are comparatively lacking in great collections of insects, there are still many points at which creditable collections occur.

As to results, the showing is very strong, as detailed under 12 headings in the address. Notably striking are the paragraphs concerning malaria. One of these significant paragraphs may be quoted:

Twenty years ago at the Mississippi Agricultural and Mechanical College for a month or more after college opened each fall the hospital would be crowded with students from the Delta section of the State who were suffering from malaria. Dozens of the worst cases would be kept in the hospital, and in addition the college physician would usually be called upon to treat several hundred milder cases. What are the conditions now? For several years the college physician has not had to treat a single serious case of malaria, and only a small number of mild cases which scarcely interfere with the students' work.

Another significant statement:

Sunflower County, Mississippi, in the center of the Yazoo-Mississippi Delta, was 20 years ago teeming with mosquitoes and malaria, yet in 1923 and 1924 girls from this county won the National Health Contest in Chicago in competition with the healthiest girls from all parts of the country, and the 1926 girl from that county tied for first place with an Iowa girl. Could this have happened 20 years ago?

In his discussion of the amateur entomologists of the South, Professor Harned refers to the men I have mentioned above and very justly adds Ed Foster of New Orleans. Mr. Foster, formerly a newspaper man connected with the New Orleans Picayune, has for many years been a shining light in entomology in the far south. A man of very thorough information, he has played a great part in many economic investigations, and at one time or another has acted as official adviser and helper in Government and State investigations.

In the discussion of Professor Harned's address, the writer said that he had just written something on the subject of entomology in the South; that he was going to tear up what he had written and write it over again when the presidential address should be published. Since then he has decided to leave it as it was and to add some statements from the address and to express his great appreciation of Professor Harned and his work.

I must add another paragraph in order to mention an interesting paper by Wilmon Newell read at the February, 1929, meeting of the Cotton States Branch of the Association of Economic Entomologists. It was entitled "Comments on Entomology in the South during the Past Twenty-Five Years." The paper is an interesting though brief summary, and mentions a number of names of younger men in addition to those we have already noticed, but does not touch upon the subject of sectional education. In this paper Mr. Newell, modestly, does not mention his own very important work except by referring impersonally to the results obtained by the Crop Pest Commission of Louisiana with powdered arsenate of lead and to the demonstration by the Commission (really by himself) in 1909 of the fact that the boll weevil could be profitably poisoned. Great credit should be given to Mr. Newell for this work and also for the remarkable work he has done in Florida culminating with the great struggle now going on (January, 1930) against the Mediterranean fruit fly.

In a paper entitled "The Modern Trend in Entomology" read by Mr. Newell before the Science Seminar at College Station, Texas, on February 8, 1929, he gave a very broad consideration of the general problem, and in his section on "Eradication" includes the following paragraph:

Unfortunately, attempts at the eradication of introduced insects in the United States have not been characterized by general success, but rather by temporizing and delay while the coveted opportunity has slipped away.

It is a very striking fact that only a few months after this paper was delivered Mr. Newell was confronted with the appearance of the fruit fly in Florida, and went at the emergency without temporizing and without delay.

ECONOMIC ENTOMOLOGY IN CALIFORNIA

California is one of two States in the Union which might be entirely self-supporting. It contains practically every climate, every kind of soil, abundant mineral resources, and can grow all things needed for human support. It has had but a short history as an agri-

cultural State. It has a rapidly growing (already very large) population which seems to be unanimous in its loyalty to the State and in its opinion of the advantages of residence in the State, but which otherwise is very heterogeneous. For many years the political management of the State has wavered from good to bad and back again. For many years the railroads were said to control the State and its politics. There has been a tendency for many years for persons with strange beliefs to migrate to California, largely on account of its climate, and southern California today is known as the home of all of the heterodoxies.

With all these things taken into consideration, it is not surprising that many good things in economic entomology have come out of California, nor is it surprising that she has suffered from many unwise policies.

California was the first State to protect itself by legislation and quarantine against the introduction of new insect pests. She made up her mind in 1880 that she had quite enough of these enemies and wanted no more; and therefore passed quarantine laws in 1881 which were not only sound but which were novel in their character. She was a pioneer State in this direction. Nothing like it had been done before, except for certain laws passed by certain European countries during the *Phylloxera* and potato beetle crises a decade earlier.

Having passed these wise laws, for which the damage done in the State by certain injurious insects had given abundant cause, we would naturally expect that California would have gone ahead wisely and focused the energies of some of her best men on the best ways to handle the injurious insects already present. But, as just stated, the State has suffered from her politicians, and the wrong men controlled her policies, from the view-point of agriculture, for many years.

A good man, lacking in scientific knowledge it is true, but one with rather sound ideas on the whole, named Matthew Cooke, an Irishman by birth, who had migrated to the United States in 1850 and who was a progressive fruit-box manufacturer at Sacramento in the late 1870's, made an address before the State Fruit Growers on January 6, 1879, which indicated some knowledge of insect pests. Later he wrote articles on entomological subjects for the newspapers. On March 4, 1881, a State act was signed which defined the powers of the State Viticultural Commissioners and protected the interests of horticulture and viticulture, and Cooke was appointed the first Chief Executive Horticultural and Health Officer. He formulated a set of six quarantine regulations and fifteen rules, and made

a very efficient officer. A State act of 1883 provided for a State Board of Horticulture, and the position occupied by Cooke was abolished.

The interest of this man in entomology probably arose from the fact that his business as a box-maker was endangered by the probable increase of fruit enemies. In 1883 he published a book entitled "Injurious Insects of the Orchard, Vineyard, Field, Garden, Conservatory, Household, Storehouse, Domestic Animals, etc., With Remedies for Their Extermination." Such portions of the book as were obviously written by Mr. Cooke himself are interesting though naive, and the word "Extermination" in the title was evidently his own choice.

Fortunately, he was able to borrow a good series of illustrations from Riley, Comstock, and others. In his preface, the author acknowledges the assistance of D. W. Coquillett, a trained entomologist who had left Illinois not long before and had settled in southern California since he was threatened with tuberculosis. Prof. E. O. Essig, who has been preparing an historical work on California entomology, writes me that, although Coquillett's assistance is acknowledged, he is inclined to think that he had little or nothing to do with any of Cooke's manuscripts. Professor Essig infers this from the fact that Cooke did not include in his bulletin many of the interesting insects that had been studied by Coquillett in southern California and from the fact that communication was not easy between two such widely separated men. As to acknowledgments, it is interesting to note that Cooke in his preface acknowledges, in addition to Coquillett's help, the assistance of the man who bound his book and also the help of the foreman of the printing company who, it seems, was a careful proof-reader. Until I consulted Professor Essig, I was of the opinion that Coquillett must have written many pages of the Cooke book.

On the whole, however, Cooke was a very useful man. He surely did no harm, and equally surely he did a great deal of good. Unfortunately, the new office succeeding his was filled by a series of, I will not say unwise men, but men who were badly informed and badly advised on the subject of injurious insects; one of them, at least, being a man whose *bona fides* apparently was not of the highest rank. As a result, the farmers and fruit-growers of California were officially misled for many years, and the teaching at the Agricultural College of the University, unfortunately, did little to offset this.

In 1888, when the Australian ladybird was brought over and liberated the Citrus groves of the State from the blight of the white

scale, the State went wild on the subject of bringing over beneficial insects from Australia. The best known and the most influential horticulturist of the State, Mr. Elwood Cooper, of Santa Barbara, allowed himself to go so far in his enthusiasm that he advocated the non-use of any other measures and the devoting of enough money to foreign expeditions for parasites and predators to accomplish "the extermination" of all of California's insect pests. Mr. Cooper's enthusiasm was so great that he was followed by almost every one, the politicians from policy, and even the cautious people because of his well founded reputation as a successful horticulturist. He himself eventually became Commissioner of Horticulture, and until his death exercised a very great influence.

There is no doubt that Mr. Cooper was an admirable man. I visited him at his great olive ranch near Santa Barbara in 1898 and was much impressed by his personality. His name was prominently mentioned for the position of United States Secretary of Agriculture a little later, and had he been appointed to this position, his friends said, he would have immediately reorganized the entomological service of the government and discharged every one who did not hold his extreme views on the subject of natural control. Very fortunately for economic entomology in the United States, this did not come about. I saw him again years later (with his second wife) in the horticultural offices in the Ferry Building in San Francisco. He was cordial, and told me that he was writing a general book on the subject of natural control of insect pests of the orchard, and I surprised him by telling him of the article in the Department of Agriculture Report for 1880 in which the practical use of parasites of orchard scale-insects was discussed. He had thought until that time that natural control was a California invention. Not long after that meeting he died, and his book was never published. It is a pity that in the period following the dramatic results of the introduction of the Australian ladybird a violent controversy arose between Professor Riley in Washington and Mr. Cooper, and especially Mr. Frank McCoppin who had been at the head of the American Commission at the Melbourne Exposition, as to the personal credit to be given for the wonderful results of this introduction. So bitter was this controversy that Mr. Cooper did not hesitate to decry all of the utterances of the entomological force at Washington and greatly to underestimate the value of its work. Mr. McCoppin was especially bitter, and virtually claimed the whole credit for himself. It is true that Koebele, drawing salary from the Department of Agriculture at Washington, was sent to Australia at the expense of the fund appro-

priated by the United States Congress for representation at the exposition in Melbourne, but only after agreement on a *quid pro quo* which included the sending of another salaried official of the United States Department of Agriculture (F. M. Webster) to Australia to make a report to the Commission on the agricultural features of the exposition.

So great an enthusiasm for natural control was aroused in California by the success of the Australian ladybird that the State made apparently no advances in her fight against insects for many years. Mechanical and chemical measures were abandoned. The subject of natural control held the floor. It is safe to say that a large share of the loss through insects suffered by California from 1888 until, let us say, 1898 was due to this prejudiced and badly based policy.

With the disappearance of Mr. Cooper from the scene, things changed, but not entirely satisfactorily. The State continued its explorations for parasites, and did it in an unscientific way and with the help of men of insufficient scientific training. Probably the Commissioner felt himself forced to continue the policy (somewhat modified) on account of popular opinion, but dangerous importations were made and much time and money were wasted. Visiting Sacramento, I tried to show the Commissioner the danger and the waste, but the work was not reorganized.¹

The situation cannot be said to have assumed a scientific phase until the appointment of A. J. Cook as Commissioner of Horticulture in 1911.

As it happened, conditions had grown so dangerous through the action of the State in supporting an explorer for parasites who himself was not trained in entomology and who was unable to give a just estimate of the importance of the forms that he introduced that the Department of Agriculture at Washington, under Federal legislation that had been enacted (1905), was about to take steps to prevent the bringing in of any living insects by the State of California. One of the first acts of Professor Cook, however, was to appoint Harry S. Smith, a trained worker in parasites, who had been for some years one of the trusted investigators of the Federal entomological service, to take charge of the parasite work for California. Mr. Smith assumed charge of the State Insectary at Sacramento and held this position

¹ Shortly after this interview, I received at Washington, from one of the traveling agents of the California Department of Agriculture, some parasitized specimens of the European *Euproctis auriflua*. The agent had taken this insect for the brown-tail moth and had sent me these parasites to show what he could do for the government. This sending was dangerous, since the host insect has never been found in the United States although occasionally a pest in Europe.

until he was transferred to the University of California and placed in charge of the entomological work at the Citrus Experiment Station at Riverside, but he has had virtual charge of all of the Californian parasite work from the time of his original appointment until now (this is written in February, 1929). During the greater part of this time Mr. Smith has been a paid collaborator of the Bureau of Entomology and has been in constant correspondence with Washington, consulting freely concerning practically all of the parasite problems of the State.

Before leaving this subject it will be of interest to mention an instance in which California attempted to interfere with an important parasite matter.

In 1905 the State of Massachusetts took up the matter of the introduction of European parasites of the gipsy moth and the brown-tail moth, and appropriated \$10,000 for expenditure in each of the years 1905, 1906, and 1907 for this purpose. The work was placed in the hands of the Chief of the Federal Bureau of Entomology. Certain citizens of Boston had been impressed by the claims of the California State Department of Horticulture and were disappointed by the slow results of the work which was carried on during the first two years in Massachusetts. Mr. Cooper told these citizens that he would have his traveling agent send to Boston "the parasite of the gipsy moth" and would guarantee its success provided the State would put the sum of \$30,000 in escrow for eventual compensation in case of success. This caused much difference of opinion in Massachusetts, and the legislature of that State appropriated an additional sum of \$15,000 to enable the Superintendent in Charge of the Gipsy Moth Work to secure expert advice as to whether the work was being carried on in the right way. With the help of this sum, a number of highly trained American and European entomologists (all acknowledged experts) were brought to Boston, examined into the work and reported enthusiastically in favor of the operations as they had been originally planned. This story is told here as an evidence of Mr. Cooper's misguided enthusiasm which caused for a time much confusion in the minds of many people and necessitated the expenditure of a large sum of money.

During the past few years California has gone rapidly ahead in all matters relating to injurious insects. They seem determined to prevent the introduction of new injurious species and to control those already within their boundaries. Apparently they spare no expense, and it is difficult to see how such matters could be handled in a more efficient way. I have in my hands, for example, at the present moment

(December 30, 1929) the Annual Report of the Agricultural Commissioner for the County of Los Angeles for 1929, and the extent of the operations in regard to insect control is amazing. Compulsory spraying in orange groves is carried on in that county, and a great deal of it is done by the county authorities; 29,299 acres were fumigated or sprayed, for example, during the past year. The county has employed no less than 150 permanent and temporary horticultural inspectors and no less than 103 temporary insectary employees. The quarantine service has been extremely rigid, and during the past nine years no less than 10,159,300 trees, plants, and packages, coming into the county, have been inspected. The extent to which one of the California counties is distributing ladybirds for the destruction of the Citrus mealybug is shown by this report. Fire destroyed one of the laboratories on March 29, causing loss of material for the production of four million beetles, but this plant contained only one-third of the total available productive material. By extending the facilities at the other laboratory (at Downey) to the limit, borrowing 320,480 ladybirds from the Ventura County insectaries, and the direct purchase by Citrus growers cooperatives of 1,264,890 beetles from outside insectaries, which were delivered to the county insectary for liberation, it was possible to carry out a seasonal liberation program as planned. A total of 6,472,970 ladybirds was handled, and these were liberated over 1,067 Citrus estates, representing a total of 11,043 acres. And yet all this was done in one county! What must the great State have done as a whole?

During the earlier period there was at least one good man who kept his head and who deserves much praise. That was Alexander Crow. While closely associated with Mr. Cooper and other important men in California, he was greatly interested in other aspects of applied entomology than the one of natural control, although he was deeply interested in the success of the Australian ladybird and believed in the carrying on of much work of that kind. He was made Quarantine Officer of the State Board of Horticulture at an early date, and did admirable service in the administration of the State's pioneer quarantine regulations. His grasp of the entomological problems of the State was admirably displayed in his bulletin entitled "Destructive Insects; Their Natural Enemies; Remedies and Recommendations," published in Sacramento in 1891. It is a comprehensive paper of 50 pages, very well illustrated and giving a good summary of remedies and of spraying apparatus. It is of note that he lists 64 dealers in spraying machinery in the State of California.

Following Mr. Craw, other good men sprang up in the service of the State or of the different counties, and today California ranks as one of the soundest States of the Union in matters relating to economic entomology. Admirable teaching is conducted at the University of California, at Stanford, and at the School of Tropical Agriculture at Riverside (formerly the Citrus Experiment Station).

Few States have as good a roll of distinguished workers as California has in her State Department of Agriculture (under the able and enlightened Commissioner, G. H. Hecke) and in her universities and in her county work. W. B. Herms, E. O. Essig, E. C. Van Dyke, C. W. Woodworth, H. P. Severin, at Berkeley; S. B. Freeborn at Davis; H. J. Quayle, and Harry S. Smith at Riverside, are all employees of the State University. R. W. Doane and G. F. Ferris teach sound entomology at Stanford. Mr. Hecke has D. B. Mackie and T. D. Urbahns at Sacramento, and a corps of excellent port inspectors at San Francisco under Fred. C. Brosius. Does any State make a better showing?

LATER WORK OF THE FEDERAL BUREAU

In earlier sections we have traced the early growth of the Federal service in applied entomology, and in a later section have spoken especially of the impressive events of the latter portion of the last century that attracted wide-spread attention to the necessity for strenuous efforts to increase the efficiency of economic entomologists and to increase their numbers.

As the century ended the case was obvious; there was no need for argument. The man at the head of the Department of Agriculture, Mr. James Wilson, had broad views. He knew agriculture. He had been head of one of the great agricultural colleges. He had been a Member of Congress. He therefore grasped the situation and knew what to do and how to do it. Appropriations for the support of the investigations of the entomological service were increased, slowly at first but with increasing rapidity. It will not be important to describe in any detail the steps that followed in more or less rapid succession, but in the first five years of the new century we were placed in a position of vastly greater efficiency, although there was no radical change in policy and the successive stages of growth and reorganization came about gradually and smoothly.

There occurred toward the end of the century a movement which resulted in a rather radical rearrangement of the working forces of the Department as a whole. There had been but two bureaus—Animal Industry and Weather. The other scientific work had been

divided into a large number of so-called divisions, the chief of each of these divisions reporting directly to the Secretary of Agriculture. About 1898, Dr. B. T. Galloway, the chief of one of these divisions (that of Vegetable Pathology) had a mild nervous breakdown and went to California for his health. With nothing to do but to think for some weeks or possibly months, he evolved the idea that many of these divisions could be grouped together in bureaus and that only the heads of the bureaus should report directly to the Cabinet official in charge of the whole Department. Naturally this plan included the grouping of all of the divisions relating to plants, such as for example the Divisions of Botany, Agrostology, Vegetable Pathology, Pomology, and the like, into a single bureau under some such title as Bureau of Plant Industry. Going further, the divisions relating to animal life, like the Divisions of Animal Industry, Biological Survey, and Entomology, he thought, might be brought together in a Bureau of Animal Industry; and so on. When he returned to Washington with his health entirely restored he announced his plan to Secretary Wilson. The latter had from the start been impressed by Doctor Galloway's ability—possibly the fact that both were Scotsmen made their mutual confidence a trifle closer than it might otherwise have been—and Doctor Galloway was told to sound out the different chiefs of divisions and get their opinions. The result was that the Bureau of Plant Industry was established. The Division of Entomology and the Division of Biological Survey were, however, not brought under the Division of Animal Industry which in itself was made a Bureau. Some independent divisions or offices still remained unassigned to bureaus. I remember very well when Dr. W. A. Taylor, then Chief of the Division of Pomology, and Dr. A. F. Woods, then Assistant Chief of the Division of Vegetable Pathology, came to me as emissaries to suggest that the Division of Entomology be incorporated with the other units into the Bureau of Animal Industry. I objected strenuously from the start. I greatly wished to preserve the practically absolute autonomy of the organization and to retain the privilege of direct consultation with the Secretary of Agriculture. The work of the Entomological service in its field and in its technique, in its literature and in its collections, varied so greatly from anything else among the Department activities that it should be kept apart.

Very fortunately, I think, on the whole, my views were heeded and the entomological service was left as an independent division until later (1904) it was made a bureau by the adoption of the term in the Agricultural Appropriation Bill of that year.

I have just stated that changes in the service came smoothly and without abrupt action. A very important step was taken, however, in 1902, and the credit for this step must be given to Doctor Marlatt, then First Assistant Entomologist. During the summer of that year I was in Europe, largely for the purpose of looking into matters relating to silk culture, and in my absence Doctor Marlatt prepared the Annual Report. In that report he submitted a plan of organization of work, which follows, and recommended its adoption in the appropriation bill for the fiscal year 1904.

Field crop insect investigations:

- (a) Southern section—cotton, tobacco, sugar cane.
- (b) Northern section—cereals and forage plants.

Fruit insect investigations:

- (a) Northern section—orchard fruits, deciduous.
- (b) Southern section—citrous and other tropical fruits.

Small fruit and truck crop insect investigations.

Forest and forest product insect investigations.

Insecticide and insecticide machinery investigations:

- (a) Section of field operations and experiments.
- (b) Section of chemical analyses and tests.

Investigations of insects affecting stored products.

Investigations of insects in relation to disease of man and animals, and as animal parasites.

Special insect investigations—miscellaneous work:

- (a) Section for the investigation and introduction of beneficial insects, and quarantine work.
- (b) Section for fungous and other diseases of insects.
- (c) Section for special insect investigations—emergency work and unclassified.

Insect laboratory, collections, and experimental garden.

Apicultural investigations.

Sericultural investigations.

Librarian and bibliographer.

On my return to Washington in the late summer, I found the plan excellent. Secretary Wilson recommended it to Congress, and it was at once adopted by the appropriating body. Prof. F. M. Webster was formally placed in charge of Field Crop Insect Investigations, Dr. A. L. Quaintance of Fruit Insect Investigations, Dr. A. D. Hopkins of Forest and Forest Product Insect Investigations; Doctor Marlatt took charge of the Insecticide and Insecticide Machinery Investigations; the Investigations of Insects Affecting Stored Products were assigned, with the truck crop insect investigations, to Dr. F. H. Chittenden; the Apicultural Investigations were continued in charge of Dr. E. F. Phillips, and the other topics were in general assigned to the especial charge of the Chief of the Bureau.

The classification of the work adopted in 1904 has held with comparatively few changes since that time. Dr. W. D. Hunter was placed in charge of the Southern Field Crop Insect Investigations, including cotton, tobacco, and sugar cane, but, as he developed strong interest in the general subject of insects in relation to diseases of man and animals, that section was assigned to him, and excellent work was carried on under him on insects affecting live stock, and a little later on the Rocky Mountain fever tick in the Bitter Root Valley of Montana. Later still the investigations of insects affecting stored products was placed under the leadership of Dr. E. A. Back. Two independent sections grew up—the one on the gipsy moth and the brown-tail moth, and the other on the Japanese beetle.

As an interlude, something should be said on the subject of sericultural investigations, since this section was dropped a good many years ago. Silk culture had always attracted a certain number of individuals in North America; and in colonial days a considerable amount of silk was raised by colonists in Georgia and South Carolina. While in Missouri, Riley became interested in the subject, succeeded in raising the domestic silkworm on the leaves of Osage orange which was very prevalent down there, largely as a hedge plant, and published articles on the subject in his Missouri Reports. When he came to Washington in 1878, he brought eggs of his Osage orange race with him, and the rearing of silkworms was carried on at the Department in Washington. When Riley resigned in the spring of 1879 Comstock, who succeeded him, continued the work, Riley having published during his term of office a manual of instructions in silk culture which was generally distributed.

When James Wilson came to Washington as Secretary of Agriculture he took, during his early administration, a journey to the South, and came back filled with the idea that the poor people of the South might take up silk culture as a household industry and find a small profit in raising cocoons. He therefore secured an appropriation from Congress, which was repeated for a number of years. Before this, however, Riley, on his return to the Department in 1881, had secured the interest and services of Philip Walker, a Harvard graduate, whose uncle, Edward A. Serrell, resident in Paris, had invented an electric silk reel which reduced the labor of reeling cocoons. Congress at that period made appropriations for several years, one of the Serrell reels was set up in the Department of Agriculture, eggs were purchased from abroad and distributed to all applicants; and the cocoons that they raised were bought by the

Department at current European prices, reeled at Washington, and the reeled silk was sold in the open market. In this way it was demonstrated that silk culture could not be made to pay under the then existing conditions, and, since the tariff was at that time being revised by Congress, the statement was made to the Appropriations Committee that an import duty on raw silk would probably result in establishing the silk raising industry in the United States. This item was naturally antagonized by the silk manufacturers, and no provision of the sort was made.

Under the new appropriations requested by Secretary Wilson, a somewhat more elaborate test of the situation was made. I went to Europe in 1902, looked into the questions of silk culture in Italy and France, purchased at Lyons for the Department a five-basin reel of the latest pattern, and also brought over two expert reelers. This machine was established at the Department; one Italian girl, resident in the United States, and two American girls were taught the reeling operations; eggs were sent out as before; and an estimate of the cost was weighed against the sums received from the sale of the reeled silk. Conditions were found so absolutely like those of 20 years earlier that even Secretary Wilson was convinced that people could not be kept interested in raising cocoons, and his requests for appropriations for this purpose ceased.

Quite in contrast in results to the investigations of silk culture, have been the investigations relating to bee culture. Work on both of these beneficial insects belongs naturally to the Bureau of Entomology.

Some money was spent on bee culture during Professor Riley's administration, the investigations being carried on largely by Nelson W. McLain. This work was begun in 1885, and was carried on at Aurora, Illinois. The main objects were, to introduce and domesticate new races of bees, to experiment in crossing and mingling races, to try to bring about artificial fertilization, to study bee diseases, and finally to settle the greatly discussed question of bees versus fruit. Several reports of Mr. McLain's were published, and Mr. McLain's location was changed from Aurora to Hillside, Illinois, in 1887, and the work soon ceased thereafter.

In 1891 some work was done for the Department by Prof. A. J. Cook at Lansing, Michigan, and by Mr. J. H. Larabee of Vermont, and on July 1 of that year Frank Benton, a well known apiculturist, was appointed for the purpose of carrying on further investigations, and was stationed in Washington. He was largely engaged in the preparation of a manual of bee culture during the following two years. This bulletin was finally published as Bulletin No. 1 of the New

Series of the then-called Division of Entomology in 1895. It was a good bulletin and had a very large distribution. Mr. Benton continued in office until 1907, when he was succeeded by his assistant, Dr. E. F. Phillips, a well trained morphologist, who had joined the service in the spring of 1905.

Doctor Phillips continued in office until the autumn of 1924, when he resigned to become Professor of Apiculture in the College of Agriculture of Cornell University. Doctor Phillips was eminently successful in his work for the Department. He conducted many investigations of great value, and published many important bulletins and reports, as did also a number of his trained assistants.

During his term of office, Doctor Phillips' work greatly strengthened apiculture in the United States. The industry increased in character and size; and the advent of the World War, with the consequent scarcity of sugar and increased prices due to this scarcity, turned the attention of many people to sugar substitutes, honey naturally being the most prominent.

Doctor Phillips was succeeded in 1924 by Mr. J. I. Hambleton, who has very competently conducted investigations relating to the honey bees that are assuming more and more prominence.

The new century brought new problems in addition to the three great ones earlier mentioned (the gipsy moth, the San Jose scale and the cotton boll weevil), and the service soon began a phenomenal growth. The larger appropriations really began with the realization of the cotton boll weevil menace. The failure of the legislature of the State of Texas to adopt a law stopping cotton culture in the significant infested area was followed by State appropriations controlled by State officials and the rather speedy realization that the spread of the insect was not to be controlled except possibly by the aid of Federal funds. Congress was therefore urged to make large appropriations to enable the South to meet the emergency, but these appropriations were largely granted to the Bureau of Plant Industry, in the endeavor to bring about more diversified farming, thus relieving the South from the one-crop condition that existed largely. Certain of the funds were also used by the Bureau of Plant Industry in efforts to breed resistant cotton plants and to investigate the effect of different cropping methods. A small portion was given to the Bureau of Entomology for strictly entomological investigations.

As time went on and as the weevil advanced, larger appropriations were given to the entomological service which was made a Bureau in 1904.

In 1905 the Federal Government entered upon the gipsy moth work. It seems a pity now that the government did not take hold at the start, for surely the gipsy moth might have been exterminated in the United States in the early 1890's. But we thought that the State of Massachusetts could and would do it. Again, when the State stopped its appropriations in 1900 the Federal Government should have taken it up. After a study of the situation in 1897, I had concluded (see Bulletin 11, new series, Bureau of Entomology) that extermination was not far distant. However, this was not done, and in 1905, when appropriations began to be made to the Bureau for this purpose, the insect had spread from a confined territory of 400 square miles to a range of 4,000 square miles. From that time Federal Government appropriations increased rather rapidly for a number of years, and during the later years there has been a constant appropriation of large sums of money, not for extermination, but distinctly in the effort to prevent spread. The gipsy moth has become well established over the greater part of New England, and is there considered principally on the basis of a native pest, the States themselves assuming its control while the Federal Government is trying to prevent its spread into New York and regions further west.

But the people and the government were becoming more and more aware of the possibilities of very great loss by insects, and pressure on Congress was having increased effect. New problems concerning native insects, like the plum curculio and the peach-tree borer, were arising, as well as new problems concerning well established insects from vastly older importation dates, like the Hessian fly and the codling moth.

Moreover, other dangerous and new pests made their appearance. In 1906 it began to be evident that a leaf-hopper was causing the disastrous curly-leaf disease of sugar beets. In 1909 it appeared that the Argentine ant, accidentally imported some years before, was becoming a very serious matter. During the same year it was found that an imported insect known as the alfalfa weevil had begun to cause great damage to the alfalfa crops in Utah and had begun to spread. In 1912 the passage of the Federal Horticultural Act enabled the country for the first time to take adequate measures against the introduction of the Mediterranean fruit-fly, and investigations were begun in Hawaii. In 1917 two serious imported pests were found, the European corn borer in Massachusetts and the Japanese beetle in New Jersey. In the same year the Mexican bean beetle proved itself very injurious in Colorado and New Mexico, and in 1920 it was reported from Alabama, from which place it spread rapidly to the north.

In the meantime many other questions of almost equal importance arose, and the work of the Bureau comprised many scores of different projects. Some important questions were solved. The New Mexico range caterpillar offered a threatening problem in 1909. The pear thrips problem in California was solved in the same year, although in the Santa Clara Valley especially it threatened the extinction of the pear industry. In 1912 the onion thrips problem was solved, and important advances were made in many directions.

The work of the Bureau spread out enormously. It became apparent not only that insect damage as a whole was increasing but that most of the measures that had been adopted were emergency methods and were very expensive, the majority of them being chemical or mechanical. And it began to be realized that infinitely more fundamental work was necessary. The consideration of natural control was elaborated, and a great deal of work was done in the way of importing, from their native homes, the parasites and predators of the gipsy moth, the brown-tail moth, the alfalfa weevil, the European corn borer, the Japanese beetle, the European earwig, and other accidentally introduced pests.

Work on even more fundamental aspects was begun, such as the physiology of insects and their reactions. And it was found necessary to enlarge the facilities of the Bureau in its taxonomic work. This work, consisting of the accurate identification of insects, has developed very greatly. A wise cooperation has existed between the United States National Museum and the Federal Bureau of Entomology, which has resulted in the building up of a very great collection of identified insects, housed in the fireproof National Museum and presided over by competent specialists in the different groups, paid by Department of Agriculture funds. This service has been of the most important help to the more strictly economic workers of the Department of Agriculture; and it has spread far beyond this, since it has been of assistance to the economic entomologists of the different State Experiment Stations and Agricultural Colleges. Complaint has been made in some quarters of the delayed service of this branch of the work, but the demands have been too great from institutions throughout the States, and the Museum force of the Bureau will undoubtedly be enlarged.

I cannot well carry this account beyond 1927, but, although the insect menace has not diminished (in fact, it is rapidly increasing), the country is fast appreciating the danger and is preparing itself to overcome it.

Witness the following contrast: I am writing this in May, 1929. Within the past two weeks Congress appropriated \$4,250,000 in the effort to exterminate a just-discovered outbreak of the Mediterranean fruit-fly in Florida. Two years ago Congress appropriated \$10,000,000 in the effort to retard the spread of the European corn borer to the west. Contrast with this the effort made in 1875 to secure an appropriation of \$25,000 to investigate the outbreaks of the Rocky Mountain locust or Colorado grasshopper, an insect which had devastated the growing crops of four western States, causing ruin and starvation among the farmers. Congress finally passed a bill on March 3, 1876, but the pitiful amount (judged by modern standards) of \$25,000 was cut down to \$18,000.

Comparing these events, a great change is evident, but there has also been a great change in conditions—in the population of the country, in the area devoted to agriculture, in rapidity of transportation, and in an infinite number of other things—so that it is not at all sure that we have yet reached the proper appreciation of the situation. To my mind, insects must be studied more intensively and by a vastly greater number of men than at present. Looking toward the future, it seems obvious that in the long run the large sums of money now being appropriated in emergencies would be more productive if more of it were spent in the effort to learn more fundamental things about insects.

This will be a good place to introduce a table showing the appropriations for the Bureau of Entomology year by year from 1879 to 1930. What seemed to us then very considerable variations were made, for one reason or another, by Congress during the earlier years, and as an explanation of the comparatively small amounts appropriated for a few years after 1904, it should be said that this was during the second Cleveland administration when instructions had been given to all departmental heads to scale down their funds to the lowest possible amounts, and that the then Secretary of Agriculture prided himself on the economy with which his Department was administered; in fact, a distinct effort was made to turn back into the Treasury as much as possible of the amounts actually appropriated by Congress. There was apparently a feeling in the Cabinet that the Secretary who was able to turn back the most money into the Treasury was the most efficient executive. The following table has been drawn up for me by Mr. A. J. Leister.

Appropriations for Bureau of Entomology by Fiscal Years

Year	Amount	Year	Amount
1879	\$10,000	1905	\$82,450
1880	5,000	1906	84,470
1881	7,000	1907	262,110
1882	23,200	1908	326,010
1883	27,900	1909	424,960
1884	27,900	1910	527,860
1885	42,900	1911	532,180
1886	47,900	1912	601,920
1887	38,335	1913	682,340
1888	44,289	1914	752,210
1889	50,508	1915	828,720
1890	31,300	1916	829,900
1891	42,000	1917	868,880
1892	42,300	1918	1,077,255 ^a
1893	32,300	1919	1,208,680 ^b
1894	29,800	1920	1,411,360
1895	29,800	1921	1,748,460
1896	29,500	1922	1,769,280
1897	29,500	1923	2,053,080
1898	29,500	1924	1,797,880
1899	29,500	1925	2,065,848
1900	30,700	1926	2,554,743
1901	33,200	1927	12,149,668 ^c
1902	36,200	1928	3,284,265
1903	70,463	1929	2,069,728 ^d
1904	77,450	1930	2,311,764

^a Includes \$145,775 allotted to the Bureau from a fund for stimulating agriculture on account of the war.

^b Includes \$222,000 allotted to the Bureau from the fund for stimulating agriculture.

^c Appropriation of \$10,000,000 for Corn Borer Control 1927-1928, of which amount \$9,592,000 was allotted to the Bureau of Entomology.

^d For the fiscal year 1929 the appropriations for the Bureau of Entomology were reduced by \$1,472,720, by transfer of this amount to Plant Quarantine and Control Administration; nevertheless there was an increase in the appropriations for this year of \$258,183 for research work by the Bureau of Entomology.

When in 1904, as has been shown, the Division of Entomology was made a Bureau and its branches of work were grouped together into definite sections, only two of the older men to whom especial reference has been made in an earlier part of this story were made chiefs of sections. These were Doctor Marlatt and Doctor Chittenden and of these men we have written somewhat at length in earlier pages. Some brief statements may well be made here of the other men who were appointed to corresponding positions at that time or a little later. It would be very difficult, in fact impossible, for the writer to express in words at all adequately his estimate of the work done by the many other scientific men in the service during the past 20 or more years. There have been very many of them, and they have done

an enormous amount of important work. But something surely must be said especially of F. M. Webster who was placed in charge of the Section of Insects Affecting Cereal and Forage Crops, of A. D. Hopkins who took charge of forest insect matters, of A. L. Quaintance who has had charge of the important Section of Insects Affecting Deciduous Fruits since its beginning, of W. D. Hunter who had charge of Southern Field crop insects until the time of his death, and of A. F. Burgess, for many years charged with the investigations of the gipsy moth and brown-tail moths.

Professor Webster was a veteran entomologist, born in 1849, who had been Assistant State Entomologist of Illinois, a Special Agent of the United States Department of Agriculture, Entomologist of the Ohio Agricultural Experiment Station, and an assistant on the Biological Survey of Illinois. He had also been Professor of Economic Entomology in Purdue University and Consulting Entomologist of the Indiana Experiment Station. During his work as Special Agent of this Bureau from 1884 to 1892 he paid especial attention to the insects of forage crops, and made many important discoveries. Notable among these was that of seasonal dimorphism in the old genus *Isosoma*, the larvae of which are known as joint-worms. He had published many papers and was very well known in agricultural circles. He took charge of the new section, chose competent assistants, established a number of field laboratories, and built up his section into one of much prominence and great usefulness. He died in 1916. A rather full biography will be found in the Proceedings of the Entomological Society of Washington, Volume 18, No. 2, pp. 79-83 (1916).

Dr. Andrew D. Hopkins was born in 1857; was Entomologist of the West Virginia Agricultural Experiment Station from 1890 to 1902 and Professor of Economic Entomology in the University of West Virginia from 1896 to 1902. In the latter year he was taken over into the Federal Bureau of Entomology, in charge of its investigations of forest insects, and on the establishment of the Section of Forest Entomology in 1904 he was, naturally, in charge. He remained chief of this important section until 1923, when he resigned as chief of section and has since that time been devoting himself, still as an expert of the Bureau, to special research in bioclimatics, a subject which he has largely developed and which has already shown itself to be of the greatest interest and the broadest bearings. During his 19 years of work on forest insects he did many great things. He knew his forest, and he worked with enormous enthusiasm on its entomological problems. His vivid interest took him into many aspects of the work. Impressed by the enormous importance of the

bark-beetles of the genus *Dendroctonus*, he wrote a monograph of the beetles of this genus, and he studied their bionomics and established a number of broad principles that proved of much practical value when thoroughly understood and upon which much practical work was based. In spite of the fact that Dr. A. S. Packard was the author of the big volume on forest insects published before Doctor Hopkins entered the field, Hopkins was really the big pioneer forest entomologist of the United States and his work was of such a character as to make everything of the kind that had been done before seem very small. He showed himself always to be a man of vision. He knew the forest entomology of Europe from personal study, and realized from the start that, while forest conditions are absolutely different in this country, we must gain here a knowledge of forest insects at least comparable to that of the European workers. Of his newer field—that of bioclimatics—it is unnecessary to speak, since the results of his work will doubtless soon be published in book form.

Dr. A. L. Quaintance was born in 1870; was Entomologist of the Alabama Polytechnic Institute in 1894, of the Florida Agricultural College and Experiment Station from 1895 to 1898, of the Georgia Agricultural Experiment Station from 1899 to 1901, and Professor of Entomology in the Maryland Agricultural College and State Entomologist of Maryland from 1901 to 1903. He was a Special Agent of the United States Bureau of Entomology in 1903, working on cotton insects in Texas, and was placed in charge of deciduous fruit insect investigations in 1905. In 1924 he was made Associate Chief of the Bureau in charge of research work. Doctor Quaintance has been a very notable figure in the recent history of the Bureau. He is a man who is not only filled with the research spirit but who has also a keenly practical mind. He is an admirable administrator and has shown his ability in many directions. A thoroughly sound entomologist himself, he has conducted personal research in an especially difficult group of injurious insects (the Aleurodidae) and in the biology of various insects, and has shown himself an inspiring and sympathetic leader of research in the important branches of his work. He has built up modern field laboratories and has directed plans of research that have brought very important results. His keen appreciation of the value of fundamental studies has led him to initiate work through ably trained assistants in directions that had not been pushed by other workers, and many of the strong ideas adopted in practice by the Bureau have originated with him.

Dr. W. D. Hunter was born in 1875. He was educated at the University of Nebraska, and after graduation held an instructor's

position in entomology. In 1900 he became an assistant in the Iowa State Agricultural College. During the years 1897 and 1898, while still in Nebraska, he acted during those two summers as Special Agent for the United States Department of Agriculture and made investigations upon the Rocky Mountain locust in different parts of the West. In the spring of 1901 he was again made Special Agent and put in charge of work against the cotton boll weevil in Texas. From that time until his death in October, 1925, he remained in charge of this vitally important southern work. With the establishment of the Section of Southern Field Crop Insects, he was put in charge of this section, and later was also charged with the work on insects affecting man and animals. He built up a large force of excellent assistants, at first at Victoria, Texas, and later at Dallas, Texas. He made an extraordinary record during his nearly quarter of a century in the South and made a remarkable impression upon the people of the Southern States. He spent much time in travel throughout the South, and was in Washington at frequent intervals. With Doctor Marlatt and Doctor Quaintance, he made an advisory committee of three to consider the work of the Bureau as a whole. He was a sound entomologist, with great breadth of view, and possessed the all-important characteristic of impressing people whom he met with his ability and his sound and careful judgment. At his untimely death in 1925 many of us realized for the first time the extraordinary number of friends he had made in the South and his great influence in the development of economic entomology in that important section of the country.

A. F. Burgess was born in 1873, and graduated at the Massachusetts Agricultural College. He was an Assistant Entomologist to the Massachusetts State Board of Agriculture from 1895 to 1899, Assistant Entomologist to the Illinois State Agricultural Experiment Station in 1899 and 1900, and Inspector of Nurseries and Orchards in Ohio in 1900 to 1902; then Chief Inspector and later Assistant Entomologist in the Federal Bureau of Entomology. His work in the Bureau from the start was in New England, and he made his way up in the service rapidly until in 1916 he was placed in charge of the project entitled "Preventing Spread of Moths," which included only the gipsy moth and the brown-tail moth. This was one of the largest projects of the Bureau and carried the largest appropriations. It developed rapidly under Mr. Burgess' hands, and sound investigations were carried out of many new aspects of the problem. He became known as one of the soundest and most reliable of the American economic entomologists; was for many years the Secretary of the

Association of Economic Entomologists during a period when it grew rapidly in importance, and was later the President of the Association. In 1928 he was transferred from the Bureau of Entomology to the Plant Quarantine and Control Administration with the grade of Principal Entomologist and retained charge of the project of gipsy moth extermination. The research work on the gipsy moth and brown-tail moth was transferred to the Section of Forest Insects of the Bureau of Entomology.

ADDENDUM: AN INTERESTING COMPARISON

Dr. Vernon L. Kellogg, a graduate of the Kansas State University, a graduate student at Cornell, and later Professor at Stanford University, is a man who has done admirable work in several branches of entomology and who was a very prominent teacher down to the time of the World War. From the standpoint of the entomologists, it is greatly to be regretted that his efforts were diverted from our science at that time; but as patriotic citizens and as men who ought to be interested broadly in all science, we rejoice in his subsequent career. He was one of Herbert Hoover's righthand men through all the wonderful relief work carried on in Europe, and subsequently became Permanent Secretary of the National Research Council, an organization formed during the war and which has grown in a very wonderful way and now is exerting a great influence in American science.

In 1925 Doctor Kellogg planned an extensive review of the advance in all branches of science in America during a period of 50 years, and he asked me to write for him in condensed shape something that he might use in regard to entomology. The paragraphs that follow were done at that time and have remained in Doctor Kellogg's hands for nearly five years. He has just written me that his duties have been such that he has not been able to carry out his plan of 1925, and, since the statement is at the same time rather analytical and condensed, it seems appropriate to me that it should be published here.

AMERICAN ENTOMOLOGY IN FIFTY YEARS

In 1875 there were in America almost no professional entomologists and almost no teachers of entomology. Our knowledge of American insects was mainly due to the work of amateurs, and the collections were practically all the private property of these amateur collectors and workers. A number of men of very different occupations had collections of Coleoptera and Lepidoptera, but the other orders had received comparatively little attention. The American

Entomological Society, of Philadelphia, and the just-founded Cambridge and Brooklyn Entomological Societies were the only societies of entomologists, and there were no journals except the Canadian Entomologist and Psyche, the organ of the Cambridge society, started in 1874. There were practically no books except Harris' well known "Insects Injurious to Vegetation" and Packard's "Guide to the Study of Insects," and no transactions or proceedings except those of the Philadelphia society started in 1861.

The economic entomologists had recently made their appearance. Asa Fitch was closing his work on the farm and orchard insects of New York; Benjamin Dann Walsh and William LeBaron had published reports in Illinois, and C. V. Riley had issued seven of his extremely fine annual reports in Missouri.

All this was in sharp contrast to conditions in Europe where there were literally hundreds of books and dozens of entomological societies and probably thousands of collectors. A bibliographical list published by Hagen in 1862 comprised two fat volumes covering more than a thousand pages.

This contrast at that time was probably due largely to the want of books on American insects and of catalogues and check lists in the different orders to encourage young collectors. And then, teachers were wanting. Aside from Dr. H. A. Hagen at Harvard, there were no teachers, and as a matter of fact he had practically no students. Comstock at Cornell and Fernald at Orono, Maine, were soon to begin their teaching, and Packard had given a course at Orono; but at this period, although there were professors of what was then termed "natural history" or "natural philosophy," few or none of them knew enough about insects to give any broad instruction. Years before, Doctor Harris, while Librarian at Harvard, gave talks to limited classes and took them on brief field excursions, and is said to have been a most inspiring teacher, but none of his students took up entomology seriously at a later date.

The only collections worthy of note at that time and which may be termed public collections were those at Cambridge, in the recently founded Museum of Comparative Zoology, and at Philadelphia, in the building of the Academy of Natural Sciences.

Until one has assembled these data, or considered them, it is impossible to realize the comparative paucity of our knowledge of American insects only 50 years ago. A great many of them had been described and named, but largely by European entomologists, and the descriptions were published in European magazines, transactions, or proceedings; and it is pitiful to note what a large proportion of

these species were collected by European travelers in America and how few were sent over there, for identification, by local workers.

Contrasting these conditions in 1875 with the conditions that existed in 1925, it is evident that there has been a change that is little less than startling. America has assumed a commanding position in the field of applied entomology, and in the so-called more strictly scientific aspects of the study has gained a very high rank. This is not the place to search for the cause of this extraordinary happening, yet it cannot be gainsaid that it has happened.

At present there are numerous large and fairly competent public collections of insects in different parts of the country—Cambridge, New York, Brooklyn, Philadelphia, Pittsburgh, Washington, Chicago, and San Francisco—while the collections of many of the universities and colleges have assumed commanding rank, notably those at Cornell, University of Illinois, Massachusetts Agricultural College, Kansas State Agricultural College, Stanford, and the University of Minnesota. There are more teachers of entomology in the universities and colleges of the United States than there are in all the rest of the world put together, and there are almost as many publishing entomological societies in our country as there are in all Europe.

Perhaps the basic reason for this rapid change has been our crying need for relief from the enormous damage done by insects. This need has led to a demand for economic entomologists. The economic entomologists once found, these men in their work at once felt the need for consulting taxonomists, for large permanent collections. And as the multifarious projects opened up it became evident that the workers needed a broader and sounder training and that very many more workers were needed. And so the college training improved and the classes grew larger until at the present time it would seem that there are perhaps more entomologists than workers in any other field of biology in the United States.

But more workers are needed. The conditions of life, our methods of growing crops, the tremendous upset we have given to the balance of nature has resulted in such an increase of insects as Mother Nature herself never expected. And many more trained and capable men are needed in this field. Perhaps we need them just now more than any other country. Surely we appreciate their need more than any other country. And that is the reason why the United States stands at the head in applied entomology.

The great advances in general entomology have been as follows:

- (1) The publication of many books and monographs.
- (2) The building of a large number of great collections.
- (3) The founding of numerous entomological societies.

(4) The teaching of entomology in all of the State universities and colleges and the consequent coming of many specialists and many workers.

(5) The description of many thousands of species.

(6) The publication of studies of the life history and ecology of a great number of forms.

(7) Careful work on the physiology and pathology of a number of insects.

In agricultural entomology the advance has been, in a general way, as follows:

(1) The institution of research work in economic entomology at practically all of the State Agricultural Experiment Stations.

(2) The growth of the Federal service from a single worker to a body of about 300 trained men working with a large annual appropriation which in 1925 exceeded \$2,500,000.

(3) The passage of the so-called Hatch Act which resulted in a Federal appropriation by means of which an Agricultural Experiment Station was started in each State in the Union, practically every one of them demanding the immediate services of an economic entomologist.

(4) The forming of the American Association of Economic Entomologists, an organization which brings together the 600 or more workers in this field and which, through its committees, watches closely the trend of investigation, and which, through its regional meetings keeps the workers closely in touch.

(5) The discovery of many new insecticides and improved means of applying them, such as hydrocyanic-acid gas, the oil emulsions, the different arsenicals, spraying machinery, dusting machinery, the use of the airplane in arsenical dusting, paradichlorobenzene, and many others.

(6) The development of the study of natural control, especially by the introduction of parasites for the control of imported pests.

(7) The development of the idea of variations in crop methods to reduce or prevent insect damage.

In medical entomology (a branch of the subject which has come to the front in the last 30 years) some of the American contributions (aside from the discovery by Theobald Smith of the carriage of Texas fever of cattle by a tick, the discovery by Reed, Carroll, and Lazear of the carriage of yellow fever by a mosquito, and the discovery by Ricketts of the carriage of Rocky Mountain spotted fever by a tick) have been as follows:

(1) Publication by the Bureau of Entomology of a bulletin giving the biology and classification and remedial treatment for American mosquitoes, elaborating control measures especially (1898).

(2) Publication of a much larger book on the same subject (1901).

(3) Publication of a large, four-volume monograph of the mosquitoes of North and Central America and the West Indies (1912-1917).

(4) Publication of several bulletins by the Department of Agriculture and of a large book on the house fly as a carrier of disease.

(5) Extensive experimental work carried on against malaria in the delta region in Mississippi as a study of the economic bearing of malaria under plantation conditions.

(6) A study of the Rocky Mountain spotted fever, a tick-borne disease.

(7) Publication of a large number of reports giving the results of the work of trained medical observers in the United States Public Health Service on insect-borne diseases.

(8) Publication of five general works on the subject of medical entomology, as follows:

Doane, R. W. Insects and disease. New York.

Hermes, W. B. Medical and veterinary entomology. New York.

Riley, W. A., and Johannsen, O. A. Handbook of medical entomology. Ithaca, New York.

Pierce, W. D. Sanitary entomology—the entomology of disease, hygiene, and sanitation. Boston.

Chandler, A. C. Animal parasites and human disease. New York.

It has become apparent in this extraordinary growth, and more especially of late years, that the study of all aspects of entomology is of the very greatest importance. We are realizing today that we must know everything about insects, and that, therefore, the somewhat arbitrary classification of entomologists into economic or general, or "pure," is wrong, since in the last analysis all entomologists are economic workers.

LATER WORK IN THE STATES

I remember very well that when Doctor Escherich's book entitled "Die angewandte Entomologie in den Vereinigten Staaten" was published, the Russian entomologist Emelianoff, who had been in the United States for some time, criticised it by stating that in comparison with its full treatment of the Federal service it did not say enough about the work done in the States, which was really quite as good and quite as deserving of extended consideration. Emelianoff was right, although as a matter of fact he himself had studied the State work and not that of the Federal Government. But the fault was not Escherich's. I have taken it on my own shoulders in my brief account of the history of applied entomology in the United States published in Doctor Friederichs' big recently published book entitled (translated) "The Fundamental Questions and Legal Measures of Applied Zoology in Agriculture and Forestry." I accompanied Escherich on his journey through the States, and showed him, very naturally, the things in which I was most interested, in which I had a personal concern, although we did visit several State stations and he met a number of the State workers.

In just the same way I fear that I have laid myself open to criticism in the present work. But I am not able to write as intelligently and with as much detail concerning the growth of the science in the dif-

ferent State institutions. That will be taken for granted, and indeed to follow the progress in each State would be a task I could not possibly undertake. In previous sections I have expressed my high opinion of the work done in the State Experiment Stations, in the State Agricultural Colleges, and by the other State workers. The results reached by these individuals and institutions have been published and are all matters of record, easily consulted and widely known and appreciated among the economic entomologists of the world. Therefore details should really not be expected in this volume.

Of course, the workers under the Federal Government apparently have great advantages over the others. As against the men in the Agricultural Colleges they have apparently the advantage of undivided time—they have no teaching to do. As against the workers in the Experiment Stations and in the offices of the rare State Entomologists they have the advantage of greater numbers and of greater financial means. The purchase of apparatus, the access to great collections and to an extremely competent library, the possibility of buying at once everything needed, are undoubtedly great advantages. The constant meeting with fellow workers for purposes of consultation and encouraging conversations is more possible with the Federal men. There is in fact only one drawback about the Federal work, and that is that as soon as a man displays especial ability that seems to point towards administrative capacity he is put ahead and soon finds his time so occupied by the red tape of Government methods that his time for research is greatly lessened.

Nevertheless, as we look over the field for the past 30 years it must be admitted that not only have the States brought out a great mass of valuable results, but that in comparison this mass has equaled in importance that coming from Federal laboratories.

This would be the place for a somewhat detailed consideration of the growth and accomplishments of each State station, so that the accomplishments of the group as a whole could be contrasted with those of the Federal Bureau. But I have not the time or the facilities for a proper study of this kind, nor is there room to print it in this perhaps too broadly planned volume. Future writers will do this; and in fact in each station some one some day will display historically the achievements of his own service. The day will come when a record of the valuable work done in each State organization will fill a book as big as this one.¹

¹ Dr. A. C. True, in his excellent "History of Agricultural Education in the United States 1785-1925" (Miscellaneous Publication No. 11 of the United States Department of Agriculture), gives three pages to a cursory account of

STATE DEPARTMENTS OF AGRICULTURE AND STATE SOCIETIES
HAVING OFFICIALS PAID BY THE STATE

While Asa Fitch was entitled "State Entomologist" and was paid a salary by the State his reports were published in the Transactions of the New York State Agricultural Society and this Society was responsible for his original appointment. His successors, both entitled State Entomologist, Dr. J. A. Lintner and Dr. E. P. Felt, were stationed in the State Bureau of Education.

Dr. A. S. Packard who was termed State Entomologist of Massachusetts during 1870 and 1871 published his reports as parts of the Annual Report of the Secretary of the Massachusetts Board of Agriculture.

B. D. Walsh, who published the first annual report on the noxious insects of the State of Illinois, was called State Entomologist, but his single report was published in the Transactions of the Illinois State Horticultural Society for 1867.

There have been other officials paid by the State, either connected with the State Department or State Board of Agriculture, whose reports were published in official documents or in the transactions of large State boards or societies of agriculture or horticulture. The famous nine reports by C. V. Riley on the insects of Missouri were made to the State Board of Agriculture and were published by the State in the Board reports.

As we have seen in an earlier section of this book, entitled "The Hatch Act," etc., there was, prior to 1880, apparently a State Entomologist of Alabama, J. T. Humphreys, but I have been unable to learn the facts, and I make this statement from the printed letterheads used in correspondence with Washington.

the development of entomology, perhaps especially from the experiment-station standpoint, which is natural enough, since Doctor True was for many years the head of the Office of Experiment Stations of the Department. In this statement he mentions the following facts: In 1888 there were 25 men doing entomological work in 20 Experiment Stations. In 1890 there were 35 entomologists in 28 states. In 1894 the Experiment Stations in 42 States and Territories employed 28 entomologists and 40 other persons doing entomological work in connection with zoology, botany, horticulture, etc. In 1912 there were 101 entomologists on the Station staffs, and not less than 112 persons were engaged in entomological work in the Agricultural Colleges and State Universities. In 1912, Doctor True states, the Federal and State funds devoted to instruction, research, and inspection work aggregated about \$1,600,000. We have shown in another section that in 1912 the Federal Bureau of Entomology had an appropriation of \$601,920. There was, therefore, the sum of one million dollars during that year spent by the States for "instruction, research, and inspection."

I have been through the Directory of Agricultural and Home Economics Leaders of the United States and Canada (Tenth Edition, Cambridge, Mass., 1928) and I find the following:

Alabama: A Chief Apiarist.

Arizona: A Commission of Agriculture and Horticulture having on its staff among others a State Entomologist, a District Entomologist, a Bee Inspector, and a Chief Crop Pest Inspector.

California: Under the State Department of Agriculture there is a Division of Plant Industry containing a Bureau of Plant Quarantine and Pest Control. In this Bureau there is an Entomologist and two Assistant Entomologists.

Georgia: Under the Department of Agriculture, there is a State Entomologist.

Illinois: A Division of Apiary Inspection, a Chief Plant Inspector.

Indiana: Under the Department of Agriculture there is a Division of Plant Pest Control employing several entomologists. There was at one time a so-called State Entomologist.

Kansas: Under the Board of Agriculture there is a specified Entomologist. There is, moreover, a State Entomological Commission of five men under this Board, and two of these are entomologists.

Louisiana: Under the Department of Agriculture and Immigration there is a Division of Entomology with a State Entomologist.

Maine: Under the Department of Agriculture, Division of Plant Industry, there is one entomologist with the title of Field Agent Gipsy Moth Work. There is also a corps of field inspectors.

Maryland: Under the State Board of Agriculture there is, in the State Horticultural Department, a State Entomologist and an Assistant.

Massachusetts: There is under the Department of Agriculture a Division of Plant Pest Control with a Director and one or more assistants.

Michigan: There is a force of orchard and nursery inspectors.

Mississippi: There is a State Plant Board with an Entomologist and six or more assistants.

Missouri: There is a State Apiarist.

New Hampshire: A State Entomologist (O'Kane).

New Jersey: A State Entomologist with an assistant in gipsy moth work and one in Japanese beetle work. There is also a Japanese Beetle Suppression Agent, and a Bee Inspector, as well as Nursery Inspectors.

North Carolina: The Department of Agriculture has an official with the title Entomologist (Leiby).

Ohio: Under the Department there is a State Apiarist with five deputies.

Oklahoma: A State Bee Inspector, under the State Board of Agriculture.

Pennsylvania: Under the Department of Agriculture is a Bureau of Plant Industry in which there is a Chief Entomologist with five assistants and a Chief Apiary Inspector.

Rhode Island: Under the Department of Agriculture there is a Chief of the Bureau of Entomology and Plant Pathology.

Tennessee: The Department of Agriculture has a Division of Plant Disease Control with a State Entomologist, and an Assistant State Entomologist. There is also a State Apiarist.

Texas: The Department of Agriculture has an Entomological Division, the Chief being R. C. McDonald.

Vermont: Under the Department of Agriculture, Harold L. Bailey carries the title "Department Entomologist." There are also three Apiary Inspectors.

Virginia: In the Department of Agriculture there is a Division of Botany in which the Chief Botanist, G. Talbot French, is also State Entomologist. There is an Assistant Entomologist.

West Virginia: Under the Department of Agriculture is found W. E. Rumsey, Entomologist.

Wisconsin: Under the Department of Agriculture there is a Section of Insect and Plant Disease Control, with E. L. Chambers as State Entomologist, and an Assistant and a Chief Apiary Inspector.

From this it appears that in 1928, 27 of the 48 States were employing one or more entomologists in their Departments or Boards of Agriculture. And in each of these same States were one or more other organizations, such as the State Agricultural College or the State Agricultural Experiment Station, also employing entomologists. In the other 21 States the entomological work is done by the officials of the Agricultural Experiment Stations partly supported by the Federal Government. There is, of course, some overlapping, and in some of the States the chief entomologist of the State Experiment Station also holds from the State Department of Agriculture the title of State Entomologist.

It is safe to say, however, that the bulk of the research work on injurious insects in the United States is done by the officials of the State Experiment Stations and by the force of the Bureau of Entomology of the United States Department of Agriculture.

THE SALARIES OF ENTOMOLOGISTS

To the physician, to the lawyer, to the commercial man, in fact to almost every even moderately successful individual, the salaries paid to entomologists in this country down to very recent times must have seemed pitifully small, but those who held this estimate have overlooked the fact that most of the men working in economic entomology were engaged in the pursuit they loved best. In other words, they were gaining a living, even though a poor one financially, by doing just what they wanted to do. So that, instead of leading, as some have expressed it, self-sacrificing lives for the benefit of the public, they have really been leading in a way self-indulgent lives of pleasure which might almost be termed selfish lives.

It will be interesting to make a brief survey of the range of salaries, in so far as the facts are available, during the last 50-odd years. We have mentioned the compensation given to Harris for his report on

"Insects Injurious to Vegetation" in Massachusetts. The salary paid to Asa Fitch, the first State Entomologist, was \$1,000. The salary paid to Townsend Glover in 1863-1877 was \$2,000. The salary paid to Riley when he succeeded Glover was \$2,000 a year. That paid to Comstock during his two years as chief entomologist to the United States Department of Agriculture was \$1,900 and \$2,000. When Riley returned to the Department in 1881, the salary was advanced to \$2,500, and there it remained for many years and was my own salary when I succeeded him in 1894. In 1902 it was increased to \$2,750; in 1904 to \$3,250; in 1906 to \$4,000; in 1911, to \$4,500; in 1919, to \$5,000; in 1924, to \$6,000, and in 1925 to \$6,500. During all these years the salaries of the principal assistants in the Bureau were being gradually raised from \$1,200.

The salaries at the present time are in very marked contrast to those of earlier years. The Chief of the Bureau now receives \$8,000. There are two who receive \$6,400 a year each; one who has \$6,000, two have \$5,800, six have \$5,600, one has \$5,200, two have \$5,000, and forty-six have from \$4,000 to \$4,600, no less than twenty-eight of these receiving \$4,600 each.

Of course, the compensation in other walks of life has also increased, either correspondingly or much more greatly. The vastly increased cost of living brought about largely by the World War is naturally responsible for much of these increases, but I like to think that the good work done by the economic entomologists and the rapidly increasing appreciation of the value of these services on the part of the intelligent public have been measurably responsible.

In other branches of scientific work under the government similar increases have been made, but I am inclined to think that the contrast between earlier conditions and those of the present are even more marked with the economic entomologists than they are in many other branches of science. I recall very well when in the 1880's Dr. William Trelease was made Director of the Shaw Botanic Gardens in St. Louis he was given a salary of five thousand dollars a year, and at that time that sum seemed princely. It stood out painfully alone among the salaries paid to biologists.

As to the salaries paid to the men working under the States, either in the colleges or in the experiment stations or under the State Departments of Agriculture, I have no sure information. That many of them have been absurdly underpaid is certain. I remember that in one case that came to my attention a few years ago a man who had long held the position of State Entomologist, had done service of the highest rank and had reached a commanding position in the scientific world,

told me that he had worked for years and had raised and educated his family of children on a salary of \$2,500 a year.

In 1929 a report was published by Congress entitled "Report of Wage and Personnel Survey," drawn up the Personnel Classification Board. From this report it appears that the salary figures presented for the comparable grades indicated that the government salaries were superior to those paid by the universities, and that in the case of land-grant institutions the workers in every rank were receiving considerably less than government employees holding approximately corresponding positions, the differences in the respective instances varying from \$761.66 to \$900.85. The opportunities for outside work during the long summer vacations, however, undoubtedly have resulted in the reduction of this apparent discrepancy. It is interesting to note from this report that whereas 69 per cent of those in the Federal service received \$3,500 or less per annum, only 46 per cent of those in educational institutions received this figure or under. In a general way, of course, these figures hold for the men doing entomological work.

Such cases as that cited in the next to the last paragraph were I believe not exceptional. But rather recently there has come a change and the men in the colleges and stations are much better paid. For principal men, salaries ranging from \$4,000 to \$5,000 are not uncommon; in fact, I believe that there is one at \$6,000, and even one in a State university at \$6,500. Here, however, and in fact in many cases the duties of the officials combine teaching with research and the direction of research. I do not wish the inference to be drawn that the salary situation is satisfactory in the States or commensurate with the value of the services rendered, for I am informed that there are several important posts in the entomological service of the State Experiment Stations that are still underpaid, a number of salaries ranging below \$4,000, in one case as low as \$2,700.

These statements regarding States have all concerned head men in entomology. The assistants, even the principal ones, were very poorly paid as a rule prior to, say, 1920. In one of the prominent midwestern States, for example, the highest salary paid to a principal assistant prior to 1920 was \$1,800 a year. But since that date the rate of compensation has increased considerably. In the same State under consideration at the present time field men are being paid from \$2,700 to \$3,000, research men \$3,000, and so on.

From the financial point of view it seems strange that more of the promising and competent young men have not left the Federal Government and the States to go into commercial work such as the great and rapidly growing industries dependent on the warfare against

insects. There have been instances of this kind, and in fact instances in which the financial urge of a rapidly growing family has turned men into quite different pursuits. It may incidentally be stated that it is encouraging to the men who have stuck by research to note that in some instances such men have voluntarily returned to research work and have taken positions once more in Federal or State laboratories.

A notable instance of the rapidly growing appreciation of the value of the services of an expert entomologist of high scientific rank has just come to my attention. Dr. Royal N. Chapman, of the University of Minnesota, is stated by the newspapers to have been engaged by the Pineapple Growers Association of Hawaii for a period of some years at an annual salary of \$20,000.

I have referred in a former paragraph to the love of their work that has kept most salaried entomologists happy in the face of small finances. No married man can be happy, however, unless his wife is contented or unless she conceals from him any discontentment she may feel. And this leads me to pay a tribute to the wives of the entomologists. Those I have known have been apparently contented and therefore have been true helpmeets.

CANADA

Canada very naturally has to meet many of the same insect problems as at least the northern tier of the United States, and, since the people of the two countries are much alike, the development of economic entomology in both regions has proceeded in a nearly parallel manner. It is true that the necessity for Federal legislation in supplying adequate appropriations came much earlier in the United States, and possibly for this very reason Canada for a number of years lagged behind, since, the problems being practically identical, their solutions reached in the United States would be immediately at the disposal of our Canadian neighbors. But after a comparatively long period of this at least partial reliance upon the United States, the Canadian Government found itself in a position to support a competent service, and of late this has grown until the whole entomological world is proud of its activity and of its accomplishments.

There were no very early writers on economic entomology in Canada, but there was one publication of especial note which was published in 1857. It was entitled "Essay on the Insects and Diseases Injurious to Wheat Crops." The author was H. Y. Hind, Professor of Chemistry at Trinity College in Toronto. And this essay was given first prize of a series offered by the Bureau of Agricultural Statis-

tics of the Canadian Government in August, 1856. The Hind essay was published in excellent form in Toronto, in an attractive red cloth binding. It covers 139 pages and carries a few very fair woodcuts. I do not know that Professor Hind ever wrote anything else on entomology, but he appears to have made an extensive study of his subject before writing this essay. It is rather discursive, but then that was the custom in those days; and it goes into other subjects to some extent. The opening chapter considers the general subject of injurious insects, the second chapter discussing classification of insects, and the third taking up the Hessian fly. Chapter IV is devoted to the wheat midge; Chapter V to the wheat stem fly and other depredators; Chapter VI to rust, smut, pepper brand, and ergot; and the final chapter gives four pages to the subject of insects affecting stored grain. Chapter II contains two very interesting paragraphs relating to the former poor public opinion of entomologists and to the fact that the science of entomology during the preceding 50 years had been "slowly giving way to a more correct appreciation of its value and of the benefits which a general study of its details might confer upon mankind." The author of this interesting volume seems to have read extensively and to have absorbed the works of Harris, Fitch, Curtis, and Kollar, and to have gone further back in his study of the older European entomologists. He seems to have been especially impressed by the writings of Harris and Fitch, and brings together many Canadian reports as to damage, and to have altogether prepared an essay which was extremely creditable for that period.

The following year (1858) there was published at Toronto another essay on the same subject, this time by G. S. J. Hill. The bibliographical records show that it contained 52 pages and was illustrated. I have not seen this work.

Public support for economic entomology in Canada began in a very small way in 1870-71, when the legislature of the Province of Ontario incorporated the Entomological Society of Ontario and gave it a grant of \$500 per annum from the provincial treasury.

In 1884 the Department of Agriculture of Canada established the office of Honorary Entomologist, and this office was filled by the appointment of Mr. James Fletcher, at that time an employee of the Government Library at Ottawa and already widely known in entomological circles.

A large share of the credit for the founding of the Ontario Entomological Society and for the subsequent Government support is due to Rev. C. J. S. Bethune, for many years head master of the Trinity College School at Port Hope (on the shore of Lake Ontario, not far

from Toronto), and Dr. William Saunders, at one time a druggist, but also interested in insects, plants and agriculture generally.¹ To Doctor Saunders is given the credit for the origin of the experimental farms system of Canada and the establishment of the Central Experimental Farm near Ottawa, of which he was the first Director.

There should also be mentioned here the writings of the Rev. T. W. Fyles who published some good economic papers at an early date. Notable among them is his pamphlet entitled "Some of the Insects that Frequent the Orchard and Garden," Montreal, 1879. The illustrations are borrowed from Riley's Missouri Reports.

In 1887 Mr. Fletcher was transferred to the staff of the Central Station as Entomologist and Botanist, and from that time on, for very many years, his status was practically identical with that of entomologist to one of our State Experiment Stations except that his field was much larger. He published a report yearly in the Annual Report of the Experimental Farms. He showed himself to be a man of extraordinary energy, a most entertaining writer, and a most careful observer and one who kept the practical part of his work foremost in view. Unlike most of the American workers, he saw the necessity for keeping in personal touch with the farmers. He gave frequent talks on injurious insects at farmers' institutes, and in that way built up a very large circle of friends and admirers among the most intelligent agriculturists of the Dominion.

His reports constantly improved in character. The agriculture of Canada developed enormously. The country became richer, and more funds were devoted to the experimental farms system, but the amount that was placed at Fletcher's disposal seemed by no means commensurate with the demands of the situation. Fletcher's energy, however, his broad grasp of the subject, and his indefatigability as a writer

¹ Doctor Bethune had been writing extensively on the injurious insects of Canada from the spring of 1867 when his first paper, entitled "Cutworms Destroying Spring Wheat" was published in the Canadian Farmer. He continued to write extensively for this journal until the Entomological Society of Ontario was founded, and after that his papers are to be found in the Reports of the Society.

Doctor Saunders began to publish the year after Doctor Bethune. He also used the Canadian Farmer first, but with the founding of the Canadian Entomologist in 1868 he began an extensive series of papers published in that journal for many years. In 1883 he published an excellent illustrated book entitled "Insects Injurious to Fruits," 436 pp., 440 figs., J. B. Lippincott & Co., Philadelphia, of which a second edition was published in 1889.

and public speaker enabled Canada to keep herself abreast of the times, largely by the adoption and assimilation of American methods.

The writer considered Fletcher as one of his warmest personal friends. He always attended the meetings of the American Association of Economic Entomologists. In fact the two of us during a never-to-be-forgotten summer in Washington drafted the original constitution of this organization which was effected in fact at Toronto in 1889. Fletcher's visit to Washington during that particular summer was a great joy to himself and to the men here who met him for the first time. He had never been so far south before, and every insect and every flower and every tree and almost every person he met interested him enormously. He would stop colored boys on the street and hold long talks with them. He would spend an hour looking over the bark of a shade-tree. It was almost impossible to get him home to dinner. His enthusiasm was infectious. Every one loved him at sight, and it is no wonder that when he died in 1908 he was mourned not only over the whole Dominion of Canada but throughout the United States.

So competent a man was Fletcher and so great was his personal influence, and so completely did he adapt himself to the situation as it existed in his country, that the necessity for additional funds for entomological research in Canada was by no means as obvious as it would have been had he been a man of different character—the people were so satisfied with Fletcher and what he was doing.

On the death of Doctor Fletcher in 1908, following an operation, the authorities evidently devoted serious consideration to the choice of his successor. The question was indeed a serious one, since no one could expect to fill the place that Fletcher had won in the minds and in the hearts of his constituency. Arthur Gibson, who had been his sole entomological assistant, a well-trained entomologist and an indefatigable worker, was thought to be too young. The Ministry corresponded with the Chief of the Bureau of Entomology at Washington, asking for advice as to possible American entomologists who might be induced to take the place. There was a feeling, however, that the Dominion should rely on the old country as much as possible in such matters, and in consequence the man who received the appointment was Dr. C. Gordon Hewitt, at that time connected with the University of Manchester, who had done some sound original research work in entomology and who was said to be a most promising man. Many people were disappointed when the announcement of this appointment was made, and Hewitt surely confronted a difficult situation when he came to Canada and Fletcher's old friends

could not help but compare the apparently rather diffident young man with their old, big, broad, genial Fletcher.

In December, 1909, I met Hewitt for the first time at the Boston meeting of the American Association for the Advancement of Science. I too was struck by the contrast, and was disappointed. This, however, was only a temporary feeling, and Hewitt soon showed his worth as a sound thinker and a remarkable organizer. He rapidly gained the confidence of the Ottawa people and began to make broad plans for the extension of the entomological service. Mr. Gibson remained as his assistant. The following winter the Canadian Legislature passed an important law entitled "The Destructive Insect and Pest Act," aimed against the introduction of certain specified insect pests. The passage of this act enabled Hewitt to add to his staff a number of trained men as inspectors and field officers, and by 1914 he had succeeded in establishing entomological field stations at nine points reaching from Nova Scotia on the one side to Vancouver, British Columbia, on the other. And the service continued to grow. In 1914 the permanent staff numbered 20. In 1927 it numbered 58. Hewitt succeeded in forming four definite Divisions in the service, based to some extent on the organization of the Bureau of Entomology at Washington. These were, a Division of Field Crop and Garden Insects, a Division of Forest Insects, a Division of Forest Pest Suppression, and a Division of Systematic Entomology.

But Doctor Hewitt was not allowed to develop his broad plans to the fullest extent, for in 1920 he died. During his 11 years of service he had developed economic entomology from a small division attached to the Experimental Farms Branch to an important branch of the Department of Agriculture. Moreover, he had made friends everywhere. He was a frequent visitor to the States, and was held in very high esteem by the workers in this country—so much so, in fact, that in 1916 he was made the President of the American Association of Economic Entomologists. It is possible that some other appointee could have accomplished the results which Hewitt brought about, but it seems unlikely. He was more than a laboratory entomologist; he was a broadly trained zoologist and a field man as well. His published reports were admirable. He was the author of an authoritative book on the house fly, published in England, and during the closing months of his life he prepared a manuscript of a valuable book on "The Conservation of the Wild Life of Canada" which was published after his death. In 1916 he was appointed Consulting Zoologist to the Canadian Government and was the Canadian representative on the International Commission for the Protection of Nature. In this

capacity he worked hard on the Migratory Birds Treaty, and he drafted for Canada what is now known as the Northwest Game Act. The book just mentioned was finally published by Scribner's of New York in 1921, and contains a preface by his widow which gives an intimate and charming view of his character and career.

When Hewitt died in 1920 there was no longer any necessity for the authorities to ask the home country or the United States for any advice as his successor. There were numerous experienced and well trained economic entomologists in their own service, so admirably had this developed during Hewitt's administration. Several of them had already gained a high rank in the profession. It is a pleasure to record the fact that they were governed by the admirable civil service principle of promotion, and that Arthur Gibson was chosen.

Gibson had been the righthand man both of Fletcher and of Hewitt, and assumed the chiefship with a perfect knowledge of Canadian entomological problems and of the people, and also with an understanding and appreciation of Hewitt's plans and ambitions for the service. As a result the work has gone on steadily and harmoniously and with an increasing realization of its importance on the part of the Canadian agriculturists.

There can be no doubt that Canada's entomological problems are now competently handled by her own men. I attended an annual meeting of the Ontario Entomological Society at Ottawa in November, 1927. This was the occasion as well for a conference of practically the whole staff of the Entomological Branch. It was with satisfaction and with admiration that I listened to the sound, practical, and scientific discussions, and I left with the feeling that, if there exists such a thing as a friendly rivalry for the greatest results, the United States must exert every effort if she is to hold her own.

All through the periods of Fletcher and of Hewitt, and now of Gibson, there has been the most perfect spirit of cooperation between the Canadian service and that of the United States. Nothing could be more ideal than the conditions in this respect that have existed. Not only has perfect confidence in the ability and honesty of purpose of their neighbor held on both sides, but a warm friendship and a general spirit of camaraderie grew up rapidly and is taken on at once by the new workers who join the forces on both sides. Our problems are the same; our ends are the same, and of course we are aided in this community of spirit by the common language and by very similar methods of training. It seems to make no difference to either service whether a desirable man is a Canadian or an American; such men are employed irrespective of their birth countries by both services.

As to the education of the Canadians: There are 23 universities in the Dominion, of which six are state-controlled, four others are non-denominational, and the rest are denominational. The agricultural colleges are institutions which are more or less independent, such as those called Nova Scotia, McDonald, Oka, St. Anne Pocatiere, Ontario, and Manitoba. However, these agricultural colleges are practically all affiliated with some university empowered to give degrees. Thus, McDonald Agricultural College is affiliated with McGill University, Oka Agricultural College with the University of Montreal, and St. Anne Pocatiere with Laval University. All of the agricultural colleges teach entomology, and in the faculties of the universities that have no agricultural departments it is also taught to some extent. For example, the University of Toronto gives sound instruction in entomology under Dr. E. M. Walker; and Dr. Norma Ford of that university has done some admirable research work.

A number of the agricultural colleges, such as the Nova Scotia College at Truro and the very well known Ontario Agricultural College at Guelph, give two-year courses and grant associate diplomas. The final two years are taken at other institutions in order to get the degree. In the case of Guelph, the final two years are taken at the University of Toronto; in the case of Truro the candidate may go elsewhere. A notable example of an associate-diploma man from Truro is Loren B. Smith, of the United States Bureau, who later took his degree at Cornell. In fact, a number of good Canadians have finished their courses at American universities. Dr. A. C. Baker, of the Federal Bureau, a Guelph man, is a notable example; as also is Dr. W. R. Thompson, for many years in charge of the United States Bureau's laboratory in the south of France and at present Director of the Parasite Laboratory of the Imperial Bureau of Entomology at Farnham Royal, England.

Doctor Baker has called my attention to one idea adopted by the Canadians which, it seems, might well be used in the United States. A young man entering a Canadian agricultural college, looking towards a degree, must give evidence that he has a practical knowledge of all the usual agricultural operations. If he has been raised on a farm, this is taken for granted, but if not he must give evidence that he has worked on a farm and must bring with him a certificate from the farmer with whom he has worked that he is familiar with all farm operations. Doctor Baker himself was reared in towns and cities, and, wishing to take work at the Ontario Agricultural College, had to hire out as a farm laborer with a progressive farmer for a sufficient length of time to get experience in everything, such as

plowing, seeding, harvesting, etc. In mentioning this idea to the writer, Doctor Baker said, "All this may seem rather absurd in training for a technical profession, but I am convinced that it is a good thing, because in research work in after years it tends to keep one from flying off at an impracticable tangent. A man who has personally handled all of the various types of work on the farm has a very good idea of what he can or cannot recommend from a technical viewpoint."

It seems that the University of Saskatchewan goes even further, and requires students in agriculture to spend their summers at work upon a farm. If not, they must spend their summers in lines of work which are approved by the faculty.

It will perhaps be interesting to add some facts concerning insect damage in Canada. Mr. Gibson published an article in *Scientific Agriculture* for July, 1927, entitled "What Our Insects Cost Us," which should have been and probably was read with much interest by the farmers and fruit-growers of our northern neighbor. He shows that the value of the field and fruit crops of Canada, according to the official estimate at the end of the year 1926, amounted to \$1,140,772,251. It has been estimated in the United States that insects destroy from 10 to 20 per cent of the total value of these crops. Adopting this percentage, Mr. Gibson shows that the minimum annual loss in Canada is therefore \$114,000,000; and he shows that to this large sum should be added the losses to forest and shade trees, stored products and many other things of value. In his opinion, during recent years the loss through insects to Canadian forests has undoubtedly averaged over \$50,000,000 each year.

He makes an interesting comparison between the amount spent on the war and demobilization during the years 1915 to March, 1926, and insect damage. The war expenditures amounted to \$1,694,557,000. During this same period the losses in Canada from destructive insects, adopting a minimum estimate of \$125,000,000 a year, would for the 11 growing seasons amount to \$1,375,000,000. It is obvious that his estimate of insect damage was too low, and there can be little doubt that, without in the least realizing it, Canada suffered as much financial loss during that period from insect damage as she did from war expenses which seemed almost crushing in amount.

As was naturally to be expected, Mr. Gibson shows that the biggest losses have been due to pests introduced accidentally from other countries, but he gives important details as to losses from native insects and also points out savings through intelligent insect control work. For example, he shows that in work against grasshoppers in the prairie provinces from 1919 to 1923, more than \$77,000,000 was saved to the

farmers by the use of 72,000 tons of poison bait prepared and spread under the direction of his branch of the Dominion service. He also shows that during 1925 and 1926 the red-backed cutworm damaged the grain crops of Saskatchewan to the amount of \$6,000,000; in 1921 the western wheat-stem sawfly damaged Saskatchewan to the extent of \$12,000,000; and the spruce bud-worm is said to have destroyed 150,000,000 cords of pulp-wood in Quebec. He adds the interesting statement that this amount of wood manufactured into paper at today's price would represent a loss of \$7,000,000,000.

MEXICO

I made three official visits to Mexico before the outbreak of the great revolution which ended the long Diaz administration.

In 1898, when the subject of quarantine against injurious insects was receiving much attention (emphasized, of course, by the gipsy moth damage, the appearance of the Mexican cotton boll weevil in Texas, and the embargoes placed by foreign countries upon American fruits on account of the San Jose scale danger), the State of California had become alarmed at the possibility that the so-called Morelos orange fruit-fly of Mexico would sooner or later infest the Citrus orchards of that State, and the State had quarantined against Mexican oranges and lemons. The Mexicans claimed that this was purely a trade quarantine, since Mexican oranges from the State of Sonora had been taking the early market away from the southern Californians; and the Mexicans claimed further that the orange fruit-fly did not exist in northwest Mexico.

In October, 1898, I started out with E. A. Schwarz from Washington. He left the train in Arizona to go to Williams, and I continued to Nogales, thence taking the direct southern line through Hermosillo, Sonora, to Guaymas on the Gulf of California. I spent some days at each place. There was at that time a very considerable industry in oranges at Hermosillo and a lesser one at Guaymas. I did considerable collecting at each place, but failed to find a trace of the fruit-fly.

Incidentally, the news came of the battle of Manila Bay while I was doing some beach collecting at Guaymas. The news was received with surprised rage by the Mexicans, and a semi-intoxicated individual, recognizing me as a Gringo, drew a large knife and attempted to assassinate me. I had no hesitation, under the circumstances, in exhibiting my ability as long-distance runner. Incidentally also, I studied the tree cotton at San Jose de Guaymas, thinking that per-

haps the cotton boll weevil would occur there. None was found. Incidentally also, during this trip I made my first acquaintance with one of the kissing-bugs (*Rasahus biguttatus*).

In 1902 I made a second trip to Mexico, largely for the purpose of trying to find whether the cotton boll weevil is parasitized to any extent there. In the City of Mexico I had the pleasure for the first time of meeting Prof. A. L. Herrera, who was then the leading economic entomologist of that republic. I found him to be a man of wide reading and excellently well informed concerning the insect problems of Mexico. I called with him on the Minister of Fomento (Señor Limantour, as I recollect) and talked at length on the general problems of economic entomology. My Spanish was practically negligible, and the conversation was carried on in French. Herrera at that time spoke no English and very little French. His wife and his sister, however, spoke good French, and there was little difficulty in our mutual understanding.

With Herrera's help, I went south to Oaxaca, met Mr. Grandison, a prominent cotton broker, and took a trip to the east to a cotton-growing region, and not only failed to find the boll weevil but also failed to find anybody who knew anything about it or had ever heard of it.

On my way back to the States from the City of Mexico, I stopped at Guanajuato to pay my respects to the veteran entomologist, Alfredo Dugés. Doctor Dugés had for many years been known as the most prominent entomologist in Mexico. He was French by birth, and for many years had held the position of French Consul. He taught scientific subjects in one of the educational institutions, and had long been an ardent collector and student in many branches of natural history. He was the teacher, in fact, of Professor Herrera. I found him in his own home, crowded by natural history specimens. Snakes in alcohol, stuffed birds and mammals, boxes of insects, and plant herbaria occupied most of the available space. He managed to find a seat for me, and we chatted for a long time, particularly, as I recollect it, on the subject of mosquitoes, and mosquito-borne diseases.

My third and last trip to that country was made in 1904, the object being again boll weevil parasites but more particularly the distribution of the yellow fever mosquito at Mexican elevations above 3,000 feet. Again the results were negative as to the boll weevil, but some very interesting points were gathered concerning the mosquito. I went slowly down from the City of Mexico to Vera Cruz. The yellow fever mosquito of course was very abundant in Vera Cruz, also at Cordoba, and less so at Orizaba. The people at the latter place told

me that this mosquito had been present at Orizaba only during the past few years. It had evidently been brought up from lower elevations on railway trains and had established itself at first near the railway station and gradually spread out into the city, breeding in domestic water receptacles as is the custom of this species.

Before leaving the City of Mexico I had an interview with Dr. Eduardo Liceaga, the President of the Superior Board of Health, whom I had met the previous year at a Pan-American sanitary congress at Washington. Doctor Liceaga had been among the first to accept the conclusions of the United States Yellow Fever Commission regarding the sole instrumentality of *Aedes aegypti* as the vector of this disease. He told me of his widespread plans to control this mosquito, and enumerated the number of inspectors which were employed by his department at the different points in the yellow fever zone. I searched for such inspectors on my trip, but found none. At Orizaba I mentioned to a prominent physician the fact that Doctor Liceaga had told me that there were 18 inspectors employed at that place, and, after inquiry, he finally found a friend who had seen one Indian with a quart kerosene can and an official badge on his sombrero. It seemed to me that, although Doctor Liceaga's plans were sound, officialism in at least certain parts of the republic must have been devoted largely to the drawing of salaries. I was told that Herrera did not dare to leave the City of Mexico for fear that when he returned some one else would be holding his position; and my informant suggested that, although Doctor Liceaga was the personal physician and warm friend of President Porfirio Diaz, a similar fear held him to his post in the city and prevented inspection tours.

The result of the investigation of the distribution of the yellow fever mosquito justified the conclusion previously reached that it breeds throughout the year in only tropical, subtropical, and lower Lower Austral life zones.

This was the year of the yellow fever outbreak at Laredo, Texas, and Nueva Laredo just across the Rio Grande in Mexico. Although it was five years after the demonstration of the sole carriage of yellow fever by *Aedes aegypti* (then known as *Stegomyia fasciata*), I realized that should I return by land I would be quarantined at the Mexican border, and I therefore took passage from Vera Cruz to New York by sea. I have elsewhere told of our stop at Havana and of my call on Dr. Juan Guiteras at Las Animas Hospital, and of the up-to-date policy of the Cubans, in contrast to the reactionary policy of the Texans, in their thorough acceptance of the truth of the findings of Reed, Carroll, and Lazear.

When the revolution came to Mexico many things were upset and remained in an upset condition for many years. During the Huerta administration conditions became such in the City of Mexico that Herrera disposed of his property and started for Vera Cruz about the time of the landing of the Americans at that port. His train was stopped, and he and his family remained in Cordoba for some months while he was recovering from an attack of brain fever which came upon him. Eventually they reached Vera Cruz in a sad condition. He managed to cable to Washington, and word was wired to General Funston in command of the American expedition to the effect that Herrera had been of much assistance to the United States Government and that it was desirable that he should be cared for. No reply came, but I understand that the Herreras were relieved at once by the American forces.

Eventually, when quieter times came, they returned to the City of Mexico, and since then Herrera has regained his health, and become director of a general biological service which includes a number of branches.

In the summer of 1922, to the great delight of many of the naturalists in this country who had corresponded with Herrera and who knew his writings, he was commissioned by the Mexican government to visit the United States. He came accompanied by his youngest daughter, and spent some weeks in the eastern United States, accumulating information which he put into play immediately on his return and started a number of movements which have already developed important results and promise much for the future.

In the meantime Mexico has had a number of serious entomological problems and has developed a few good men of her own, and has utilized the services of Dr. A. Dampf (a German), the latter especially in the serious problem of an invasion by migratory grasshoppers of some of her southeastern States. A Mexican worker, Sam. Macías Valdez, has been doing excellent work with the insects affecting live stock; and other younger men are coming forward.

Mexican officials have always been exceedingly courteous to American official entomologists who have visited that country on various missions connected especially with the investigation of the boll weevil, the pink bollworm, and the orange fruit-worm, and have shown the most intelligent and cordial wish for close cooperation. It is true that rather uncomfortable incidents have occurred; such, for example, as the temporary arrest of Hunter and Coad by a party of revolutionistas, and another time the execution, by hanging, of one or more unfortunate Mexicans on a tree immediately in front of the temporary

laboratory of the United States Bureau of Entomology in the Lagunas district. It might be worth while also to mention that I was myself arrested in Cordoba while collecting insects at night on the white wall of a building under an arc light. I had climbed up on a barred window to reach a highly placed specimen, when I was caught by the police and carried off to the *cuartel*. I showed my specimens and tried to explain, but without effect. I had met the Jefe Politico in the morning and had his card in my pocket. When I produced it, they sent for the high official, who liberated me with apologies and who later gave me an official document entitling me to the freedom of the city and the right to collect insects anywhere. The point of the whole episode was that the building on which I was climbing was the principal bank of the town.

Shortly after this last visit to Mexico the serious revolutionary troubles began that resulted in the overthrow of the Diaz administration and in a long period of great unrest in which administration followed administration. At this distance I have during these years been confused as to conditions in the neighboring republic although from time to time men connected with the Department have gone down there on one mission or another. I have been fully aware, however, that important movements in applied science have taken place, and just now (April, 1930) I have been placed in possession of a comprehensive statement drawn up at my request by Dr. Alfons Dampf, on the basis of which I have constructed the following paragraphs. Many of the sentences are in Doctor Dampf's own words, and I thank him very heartily for his sympathetic courtesy.

There seems little doubt that both the Aztecs and the Mayas suffered from locust invasions. Among the Mexican antiquities, stone carvings of grasshoppers are occasionally found, and the beautiful presidential residence near the City of Mexico bears the name Chapultepec which means "grasshopper hill." Therefore, primitive applied entomology was evidently of pre-Columbian origin. At the time of the conquest by Cortez, the Spanish writers, Hernandez, Sahagun, Clavijero, and others, give data concerning insects gained from the Indians. The famous Father Antonio Alzate, after whom the well known scientific society of Mexico is named and who died in 1795, observed the pulsation in the dorsal vessel of a caterpillar and published an extensive work on the cochineal. Great collections of insects among other objects of natural history were made in Mexico during the past century, and particularly when the great work by Godman and Salvin was carried out, resulting in the publication of the famous "Biologia Centrali-Americana." The entomological parts of this work

are indispensable to the broad taxonomist, but there are no biological data whatever nor is there any indication that any of the species mentioned are of economic importance.

The publication known as "La Naturaleza" should be mentioned. Doctor Dampf calls it "the valuable Mexican scientific review." It was published from 1869 to 1914. Doctor Dampf also refers to the various agricultural journals (*Boletín de la Sociedad Agrícola Mexicana*, from 1879; *La Revista Agrícola*, from 1885, etc.) and to the official publications of the Secretary of Agriculture. In these publications there are many articles on pests, with recommendations for control, but they are mainly taken from foreign publications.

In 1900 the "Comision de Parasitologia Agrícola" was established in Mexico City as a branch of the Mexican Department of Agriculture (*Secretaria de Fomento*) and, under the leadership of Prof. A. L. Herrera, began active work, taking up at once the so-called Morelos fruit-worm (*Anastrepha ludens*). The inspectors and entomologists of the Commission comprised the following individuals: Amado F. Rangel, L. de la Barrera, Oliverio Tellez, Guillermo Gándara, Anselmo Neraz, Carlos Macias, Gabriel Blanco, Julio Riquelme Inda, Dr. Silvio J. Bonansea. The following were honorary collaborators: Dr. Alfredo Duges, Man. Tellez Pizarro, Dr. Manuel Villada, Dr. José Ramirez.

Between 1900 and 1907 there were published by the Commission four volumes (the last incomplete) of a *Boletín de la Comision de Parasitologia Agrícola* and 75 circulars concerning insect pests and diseases of cultivated plants.

In 1907 a new service was started and entitled "Dirección General de Agricultura," and all experimental and research work was concentrated in a Central Agricultural Station in San Jacinto (D. F.) with many substations in various States. The old Parasitological Commission was incorporated in the Central Station under the name (translated) "Division of Parasitology." Professor Herrera resigned, and Dr. Roman Ramirez, a phytopathologist, was appointed chief. In this Division were J. Riquelme Inda, G. Gándara and Leopold Conradt. In the winter of 1910 Professor Gándara and Senor Riquelme Inda visited Washington, and presumably other parts of the United States. At that time Professor Gándara introduced himself as Professor of Natural History and Plant Pathology, while Riquelme Inda attached to his name the words, "Perito Agrícola." Mr. Conradt had been one of the collectors for Godman and Salvin, and was entrusted with the formation of the insect collections.

This Central Agricultural Station was closed in 1914, on account of the revolution, and all scientific work was stopped. In 1915 the Direccion General de Agricultura created a new department under the name "Departamento de Plagas," with Dr. Roman Ramirez as chief, and A. Madariaga, A. Nunez, O. Tellez and L. Conradt as collaborators; and in 1917 L. de la Barreda, one of the members of the extinct Parasitological Commission, joined the force. In 1919 the name was changed to "Seccion de Plagas," and in 1923 Doctor Ramirez resigned. In 1924 the office was removed to Chapingo and incorporated in the Agricultural College as a section of the Department of Laboratories, with Madariaga, Conradt, de la Barreda and Dr. Alfons Dampf as scientific staff.

Doctor Dampf was a man of excellent training who had formerly been Entomologist of German East Africa and since 1920 had been the head of the Entomological Department of the Zoological Museum of Koenigsberg and lecturer on economic entomology. He was invited by the Mexican government to take the chair of Entomology in the National Agricultural College, and arrived in Mexico in September, 1923. There had, however, been political changes in the government, and the new administration could not fulfill the promises of the old one. He was temporarily offered a position as Microbiologist in the Department of Laboratories in Chapingo, but soon resigned and joined a commission of the Mexican Public Health Department which was going to the State of Vera Cruz to study the migratory locust which had invaded the State in a disastrous way. In the autumn of 1924 he traveled in the State of Vera Cruz, made observations on the biology of the *Schistocerca paranensis*, and published his results in 1925.

In the meantime the Section of Parasitology at Chapingo had been suppressed by the government for lack of activity, and the new Secretary of Agriculture, Ing. Luis L. Leon, organized a new body entitled (translated) "Locust Control Board," with headquarters in Vera Cruz, Doctor Dampf being appointed Entomologist to the Board. Doctor Dampf started promptly and very wisely to Yucatan, British Honduras, and Guatemala, searching for the permanent breeding grounds of the locust. He found on the shores of Lake Peten in Guatemala a sedentary form of what appeared to be *Schistocerca paranensis*. By later breeding experiments in Vera Cruz he showed the existence of two forms of the same species, just as has been done with the migratory locusts of Europe, Asia and Africa by Uvarov, Johnston, Faure, and others. In 1926 another expedition was made to the highlands of Chiapas.

At the close of the year 1926 the locust outbreak had lost its dangerous aspect and the Control Board was about to be dissolved, but convinced by a memorial submitted by the chief of the Board (Ing. Francisco Garcia Robledo), President Calles established the "Oficina Federal para la Defensa Agricola" which began operations in January, 1927. Senor Robledo was made director of the Office, Doctor Dampf Chief of the Department of Research and Pest Control, and Ing. E. Coppel Rivas Chief of the Department of Quarantine and Inspection. On the 1st of January, 1930, the Office was divided into three departments: (1) Research, with a staff of 15 persons; (2) Quarantine and Inspection, with 14 persons in the central office, and 60 inspectors; (3) Pest Control, which commands the nearly 2,000 rural associations for plant protection and organizes the campaign against dangerous outbreaks of agricultural pests like locusts, rats, etc. There is a section for publication and propaganda, and an administrative section.

Quite recently the United States Bureau of Entomology has entered into an interesting and possibly very important plan of cooperation with the Mexican government. Realizing the great desirability of a laboratory in central Mexico which should be devoted to fundamental studies on fruit-flies, a proposal was made to the Mexican government, and a prompt agreement was reached. Two laboratory buildings of the former Veterinary School in San Jacinto were taken in hand by the Mexican authorities, funds were appropriated and the buildings were put into first-class shape for modern work; so that eventually two modern concrete buildings and suitable grounds were turned over to the workers of the United States Bureau of Entomology for as long a period as desired. The Mexican officials took great pains to equip these buildings to receive the most up-to-date type of laboratory apparatus, and cannot be too highly praised for the rare vision that induced them to authorize this move in the interest of cooperative entomological research.

To go back a bit: Especial mention, perhaps, should be made of articles by L. de la Barrera and A. Madariaga in the *Agricultural Review of Mexico* for 1919, and an article in the same *Review* for 1922 on cotton insects by G. Itié. In 1921 important articles on injurious insects were published by R. Ramirez and J. R. Inda; and Señor Inda published independently, under the Antonio Alzate Society, in 1927, a report on the enemies of chick-peas.

At least two experts from the United States have worked upon certain insect problems in Mexico, entirely aside from the investigations made by Hunter, Coad, and others of their assistants in the

course of their cotton insect work. For example, R. H. Van Zwaluwenburg worked in Mexico for some time in the employ of an American company in the State of Sinaloa, and in 1926 published a report on the insect enemies of sugar cane in western Mexico. A. W. Morrill was also for several years in the employ of a great American company in Mexico largely engaged in the growing of vegetables. He has published several articles upon his work, an especially notable one being an account of the use of the airplane in dusting large plantations of tomatoes. In a special publication of the California Department of Agriculture in 1927, Doctor Morrill gives the result of five years' experience in conducting a general survey of the pests of crops on the west coast of Mexico.

An important publication which we have not yet mentioned was published by the office of Defensa Agrícola in 1929. It is entitled (translated) "Arsenic and Its Derivatives as Insecticides." It was written by two chemical engineers, Pablo Hope y Hope and Manuel de la Lama, both connected with the service.

PART II
EUROPE

PREFACE

Large as this book has grown to be, I am very conscious of its omissions, and as I send it to the printer I am fully convinced that I have not done justice to certain countries and to certain individuals. Aside from North America, I have not traveled much, although I have visited nearly all of the European countries except Greece, Rumania, Denmark, Sweden, and Norway. It is true that many entomologists from the British and Dutch colonies, from South American countries and from the Orient have visited Washington; that our correspondence covers the whole world; and that the Bureau library is supposed to be very complete. In spite of all this, however, I have not been able to satisfy myself and surely will not have satisfied a number of good workers in certain other countries. To these I offer humble apologies. I have written hundreds of letters asking for further information; but in some cases I must have chosen my correspondents unfortunately. Perhaps they were dead; perhaps they were ill; perhaps (as is undoubtedly the case with some people) they preferred other kinds of work to letter-writing. One thing, however, is certain: that criticisms of this publication will be printed and that the next historian of economic entomology will have an easier task.

OLD EUROPEAN WRITERS ON ENTOMOLOGY

I have a reverence for the fine old European writers on entomology. It has been with me from my early days. Reading only English, French, and Latin as a youth, I read Kirby and Spence at first, and Rennie's "Insect Architecture" and the English translation of Figuiet's "Insect World" and the translation of Van Bruyssel's "Population of an Old Pear Tree" and the Rev. James G. Wood and Duncan's adaptation in English of E. Blanchard's "Métamorphoses des Insectes"; then Réaumur and Lyonnet, and so on into the more technical works of the masters of classifications in several languages which I learned to translate on the basis of my college Latin, French, Italian, and German, until I thought of the great old European workers in the museums and universities as a race of supermen. I have never lost this feeling.

Looking back from this distance, I appreciate these men and their work more than ever. All of them studied insects from choice. They were fascinated by their beautiful and strange forms and by their marvelous habits and lives. They worked arduously and with indomi-

table and splendid zest, often in spite of the unconcealed derision or pity of their friends and families.

Many of these old writers wrote about other branches of natural history as well; but of those who practically confined their investigations to insects the following names stand out: Goedart, Swammerdam, Ray, Vallisnieri, Madame Merrian, Réaumur, Frisch, Clerck, Roesel von Rosenhof, Lyonnet, DeGeer, Bonnet, Scopoli, Goeffroy, Fabricius, Olivier, Kirby, Meigen, Fallen, Latreille, Wiedemann, St. Fargeau, and the small army who published in the early nineteenth century. And then such fine men followed them! Large groups were admirably monographed by them. They were learned masters in a way, but although the group that appreciated and honored them was world-wide, it was a very small group, and the world at large was ignorant of their existence, ignored their writings, and largely ridiculed the highly important field of investigation in which they spent their productive and useful lives.

Most of these men must have been keenly aware of the popular estimation of their work. Numerous writers on entomology of all nations in those days introduced their volumes with words, not of excuse, but of explanation, to justify their importance.

The rating of entomology in the public mind at the beginning of the nineteenth century was well expressed by Kirby and Spence in 1815 in the following words:

One principal reason of the little attention paid to entomology in this country, has doubtless been the ridicule so often thrown upon the science. The botanist, sheltered now by the sanction of fashion, as formerly by the prescriptive union of his study with medicine, may dedicate his hours to mosses and lichens without reproach; but in the minds of most men, the learned as well as the vulgar, the idea of the trifling nature of his pursuit is so strongly associated with that of the diminutive size of its objects, that an *entomologist* is synonymous with everything futile and childish. Now, when so many other roads to fame and distinction are open, when a man has merely to avow himself a botanist, a mineralogist, or a chemist—a student of classical literature or of political economy—to ensure attention and respect, there are evidently no great attractions to lead him to a science which in nine companies out of ten with which he may associate promises to signalize him only as an object of pity or contempt. Even if he have no other aim than self-gratification, yet “The stanchest stoic of us all wishes at least for some one to enter into his views and feelings, and confirm him in the opinion which he entertains of himself”; but how can he look for sympathy in a pursuit unknown to the world, except as indicative of littleness of mind?¹

¹ Preface to Vol. 1 of the “Introduction to Entomology.” Mr. Spence wrote this preface (see Proceedings of Entomological Society of London for August 5, 1850, Transactions, Vol. 1, new series, page 20).

An incident peculiarly significant of popular ideas occurred more than a hundred years before this statement by Kirby was published. A record is found in Moses Harris' "The Aurelian" (1776), facing his plate of a butterfly that he called "the Glanvil Fritillary." Harris' statement is as follows:

This Fly took its Name from the ingenious Lady Glanvil whose Memory had like to have suffered for her Curiosity. Some Relations that was disappointed by her Will, attempted to set it aside by Acts of Lunacy, for they suggested that none but those who were deprived of their Senses, would go in Pursuit of Butterflies. Her Relations and Legatees subpoenaed Dr. Sloan and Mr. Ray to support her Character. The last Gentleman went to Exeter and on the Tryal satisfied the Judge and Jury of the Lady's laudable Inquiry into the wonderful Works of the Creation, and established her Will.

We may approximate the date of this trial. Ray died in 1705, and had been invalided during his later years. Sir Hans Sloan was not knighted until 1716. His degree of M. D. was given him in 1683. He is referred to by Harris as "Dr. Sloan." It is therefore safe to suppose that the trial at Exeter occurred between 1683 and 1700.

Going back to the early part of the nineteenth century, Mr. H. J. Carter of Australia, formerly President of the Linnean Society of New South Wales, has called my attention to the article "Entomology" in the Oxford Encyclopaedia of 1828. There the condition at that time is well expressed in the following words: "There is not, perhaps, any branch of natural history the study of which has been so generally regarded with indifference and contempt. The insect hunter is not infrequently treated with ridicule and his pursuit branded as frivolous." Mr. Carter is responsible for the Australian story that not many years ago a naval officer who was also a distinguished entomologist narrowly escaped being locked up by the Gosford police as a person of unsound mind.

One of the old writers mentioned in a preceding paragraph was Johann Wilhelm Meigen, a remarkable worker on the Diptera, known to all subsequent workers in systematic entomology. I am reverting to him because his life was lived at that very interesting period of European history, 1764 to 1845, and because he lived at Stolberg near Aachen in the center of the revolutionary happenings of the Napoleonic wars, a region which was first German, then French, and much later once more German; and also because a rather full and very charming account of his life was written by a fellow townsman, J. A. Foerster, which should be read by all entomologists who know German. Apparently it has never been translated into English. It will be found in the *Stettiner Entomologische Zeitung* for 1846, pages

66 to 74 and 130 to 140. The story of the poor boy with his love of nature—of how he became interested in the flies and how his original attempt at classification led to his broadening of the characters used to differentiate genera—of how he first attracted the attention of Lacepède and of how he secured through him his first magnifiers—then of how Illinger met him and helped him to publish his first paper—and then the visit of Fabricius, who came from Paris to Stolberg to see him—the whole story is fascinating. He was poor all his life, but happy in his work. When he was 76 years old he was given a pension of 200 thalers a year by the Crown Prince of Prussia, and on his 83rd birthday the University of Bonn gave him a doctorate. His was a good, productive, and useful life, and in his devotion to his work he was typical of probably most of the entomologists of his day who have left notable publications.

Another case was that of Pierre André Latreille, one of the greatest systematists in entomology. He was born in 1762, and was such a modest man, so absorbed in his work and so indifferent to other matters that he remained for 30 consecutive years attached to the Museum of Natural History in Paris in an inferior position in spite of his extraordinary merit. This is a wonderful contrast to the younger men of the present age who expect to reach first rank very speedily. A writer in *Miscellanea Entomologica* twenty-odd years ago says of his work (translated): "He explored it (entomology) as a connoisseur, studied like a Benedictine monk, and described as a poet the interesting world of insects which he classified." Latreille's pecuniary reward came only when he reached the age of 65, and in 1827 he was given one of the two chairs of the Institute. He enjoyed this advanced position for only six years, and died in 1833.

In the old days, just as in recent days, the collecting and study of insects attracted people of the most diverse occupations and social standing. I have just told the story of Meigen who, beginning as a poor boy, died as a poor man, unconsidered by the rank and file of his contemporaries, but who nevertheless worked out things and published them that are today considered of high value and that must be consulted often. And with Latreille we have shown much the same thing. In fact, nearly all entomologists have been poor men—very many of them, possibly, poor *because* they were so vitally interested in entomology. But there have been some wealthy men of high position who have been attracted to this study, some as dilettante collectors, and others as ardent and intelligent workers. And this held for the old days just as it does for recent days.

I have, for example, on the wall of my library, two pictures. The one is a painting, picked up many years ago in Vienna, of the type of entomologist who was misunderstood and ridiculed and therefore became typical of a popular idea. He is an elderly man of some period more than a hundred years ago, careless in his attire, running through a field with a butterfly net, collecting insects, chasing an elusive specimen. The other picture, an old colored lithograph, shows a collector, past middle age but dressed in the height of style of the period of Buffon (1707-1788) or perhaps of Cuvier (1769-1836)—a Comte or a Baron surely—also with a butterfly net, standing in a forest glade, examining a specimen with a large hand-glass. Possibly at the time when this lithograph was drawn on stone entomology was stylish at the French court. Possibly the man was so highly placed that he could stand any ridicule of his occupation. No one knows which.

At any rate, here and there one of the nobility took up the subject. Seventy years or more ago, a London banker named John Lubbock became interested in ants. He was subsequently knighted, and later became Lord Avebury; was made a member of the Royal Society, and ranked high among England's scientific men. A man of much older title was the late Thomas Lord Walsingham who, although an ardent sportsman and distinguished in many ways, became a world authority on the Microlepidoptera and was quoted in entomological publications all over the world. The Russian revolution brought about the death of another distinguished Lepidopterist, the Grand Duke Nikolas Michailowich, a grandson of the Czar, Nikolas I. He was a man of rare culture, whose leisure was devoted both to entomology and the study of history. He published a magnificent series of memoirs on the Lepidoptera, illustrated by superb plates. For his historical work he was made a member of the Institut de France, and for his entomological work an honorary member of the Entomological Society of France. King Ferdinand of Bulgaria is another Lepidopterist of a royal family, but he does not confine his interest to insects alone, since he has always been a student of birds.

Col. Thomas A. Casey, the distinguished American Coleopterist, used to think that he was alone among the military men who were interested in entomology, but there are historic precedents, and I add, in concluding this section, two anecdotes of French officers of distinction, that I have gathered from the Transactions of the Entomological Society of France, that concerning Dejean in the volume for 1845, and that concerning Pradier in the volume for 1875.

Count Dejean, General of the Empire and Aide-de-camp to Napoleon I, was the owner of one of the greatest collections of insects that ever existed. He was an ardent collector, and never lost a chance to add to his collection. Boisduval tells the story that at the battle of Alcanizas, which Dejean won after a very hard fight in which he took a great number of prisoners, he suddenly saw near a little brook a brilliant and rare insect which was lacking in his collection. It was *Cebrio ustulata*, and it was resting on a flower. The Count was at the head of his troops, facing the enemy, and was about to give the signal to charge, but, seeing the insect, he at once dismounted, captured it, pinned it in his helmet, remounted his horse, and gave the order for one of the most vigorous charges of the campaign. After the battle he found that his helmet had been "horriblement maltraité" by a cannon-ball, but his precious *Cebrio* was recovered intact.

Boisduval states that all of the soldiers in the regiment commanded by Dejean learned to collect beetles, and each one was given a little vial of alcohol in which all the insects they collected were placed. This eccentricity of his was known to everybody—even to the enemy. So, after a battle, those who found dead soldiers on the field having with them a little bottle containing insects in alcohol, no matter which side won the victory, would always carry the little bottle to General Count Dejean. (Ann. Soc. Ent. Fr. 1845, p. 502.)

In his zeal as a collector of insects, Gen. E. E. Pradier of the French Army (born in 1813, prominent in African wars and in the war of the Crimea) was almost equal to Dejean. H. Deyrolle relates that once, in Algeria, at the beginning of the French occupation, at a time when there was a price on the head of each Frenchman, Pradier could not resist his collector instincts and often wandered far from camp. One day he was suddenly surrounded by a group of Arabs who made him understand that he should follow them. Resistance was not possible—all the more so since he was not armed. But he had taken the precaution to dress in the uniform of a medical officer (that of one of his friends), thinking that there was a chance that he would be respected as a doctor, since the Arabs allowed only men of that profession any facility in coming and going. When they arrived at the first Arab camp he was taken into a tent where there was a Moroccan woman in child labor, and he was told, in his rôle of physician, to do what was necessary. He was only a lieutenant at the time, and his embarrassment was very great. He did not know whether to try the midwife act or to allow his head to be cut off. Suddenly the idea occurred to him to try to make the Bedouins understand that he had not the necessary instruments with him and that he

would have to go and get them. So they let him go, and naturally he did not return. He used to laugh heartily in telling this story, at the idea of a French lieutenant becoming an Arabian accoucheur. (Ann. Soc. Ent. Fr. 1875, p. 251.)

EARLY EUROPEAN ECONOMIC ENTOMOLOGY

We have been accustomed of late years to think of economic entomology as an American product. On account of its very great development in this country, far beyond that in any other country, its recent developments have overshadowed a great deal of important work that was done in Europe long before agriculture in America had assumed a very great importance—when the American population was small and when only a small portion of the land had been turned into farms. American economic entomologists have grown too patriotically egotistical. Look back 60 years and read what Dr. A. S. Packard said in the introduction to his "First Annual Report on the Injurious and Beneficial Insects of Massachusetts" (1870). He complains that we are not making investigations in economic entomology at all comparably with the Europeans, and states that in Europe the subject "has always attracted a great deal of attention." He goes on to make the astonishing statement that "in the densely populated countries of Europe the losses occasioned by injurious insects are most severely felt."

For very many years we have not glanced at the early publications of European writers; we have forgotten that there were so many. The average American worker of today may remember to have seen Curtis' "Farm Insects" or Kollar's "Treatise on Insects Injurious to Gardeners, Foresters, and Farmers," but that is all, unless he should be interested in forests, since the works of Ratzeburg, Eichhoff, and others are well known to all foresters.

Hagen, in preparing his great "Bibliotheca Entomologica" for publication, evidently spent a great amount of time in his analysis of the mass of works listed, and he published at the end of his second volume more than a hundred pages in fine type of what he called a *Sachregister*. Examining this part of the *Bibliotheca* carefully, the modern entomologist will be surprised to find that there had been published prior to 1863 a very large number of papers on the different kinds of damage done by insects—so large a number in fact that Hagen devotes 11 double-column pages to their mere listing under appropriate names.

All these years we have been considering this work of Hagen's (it has become known colloquially among the workers in this country

as "the entomologists' bible") as very complete, and we have all been surprised and delighted with the recently published Index to Entomological Literature brought out by Drs. Walther Horn and Sigmund Schenkling. These indefatigable workers have found no less than 7,929 articles not listed by Hagen and all published prior to 1863, and they have brought the total number of articles on entomology published before that date from 17,300 up to 25,229. Moreover, they have discovered that there were no less than 3,326 authors writing on entomological topics prior to that date whose names do not appear in Hagen. The authors of the Index have not been able to take up the laborious task of preparing a *Sachregister* supplementary to that published by Hagen, but there are doubtless in the nearly 8,000 additional titles many that are directly or indirectly concerned with economic entomology. Of course, the list includes American writers as well as those of the Old World.

As a matter of fact a great many of these articles amounted to little from the modern point of view. The remedial measures suggested in practically all the general books and papers on economic entomology in Europe prior to 1870 have been comparatively unimportant and ineffective. A modern entomologist has spoken of them comprehensively as "old Scotch gardeners' stuff." Nevertheless, the entomologists of those days did their share in making known the life histories and seasonal habits of the insect enemies of the gardens and fields. They were not farmers or gardeners themselves as a rule, although Bouché was *Gartendirektor* in Berlin, and they knew little of such arts. Boisduval puts it very pleasantly in the preface to his "Entomologie Horticole" (1867) as follows (translated):

This book will meet with the same reproach that has been applied to all its predecessors. They complain that, while we describe the damage the insects do, we do not always point out the remedy. To this we reply that the same observer cannot do everything, and that we have always helped the horticulturists by showing them the habits of the insects against whose ravages we have not always been able to suggest remedies. In their own ranks there are many excellent observers who will soon discover how to free their gardens from these pests for which we have been able to suggest nothing.

We must not, however, fail to mention the fact not only that some common pests were rather well understood, but that there were here and there general regulations or decrees or laws calling for the hand destruction of certain forms at certain stages of their growth. Bouvier, for instance, has called attention to the old French law of the 28th Ventose, year IV of the Republic (March, 1796) especially enacted against the brown-tail moth and requiring the collection and destruc-

tion of the winter nests of this insect. This very old law, I understand, still holds, but its enforcement has "gone out of style." That it may still be enforced was seen in the region of Angers in 1910, and Bouvier in 1920 showed the necessity for its enforcement in the vast domain bequeathed to the French Academy near Montmorillon, Department of Vienne.

In the section on Sweden I have spoken of "Noxa Insectorum" printed at Stockholm in 1752, as probably the first paper on applied entomology prepared by a thoroughly scientific man; but Doctor Kemner reminds me of the paper by A. F. Krafften published in Nuremberg in 1712 and 1713. Hagen's "Bibliotheca Entomologica" mentions three titles by Krafften, but possibly all three are the same paper. I have been unable to consult them, but it is likely that they contain nothing especially significant.

The Swedish paper, although it is supposed to have been written by Linnaeus, contains little of a practical nature, and in fact from the standpoint of the economic entomologist is not of very much greater significance than the early book by Conrad von Magenbarg (1309-1374) entitled "Das Buch der Natur," known to us through Hugo Schulz's edition (Greifswald, 1892). In this book the chapter on "Worms" includes sections on the bee, the spider, the silkworm, the glow-worm, the dog-fly (probably *Stomoxys*), midges (including mosquitoes, etc.), gadfly, the hornet, the cabbage worm, ants, the antlion, grasshoppers, flies (including the house fly and the flesh flies), the flea, the louse, the water striders, the ground beetle, wood-boring larvae, the meal-worm, and the insects injuring furs (*Dermestes*, *Pyralis pingualis*), and the wasp.

After writing thus far the natural thought comes to me (it should have come at once) that of course people had to fight insects before they knew anything about them. So some sort of applied entomology must have begun before a true study of insects was taken up. Much light is thrown upon this subject in a just-published work.

Dr. F. S. Bodenheimer, of Palestine (The Hebrew University, Jerusalem), has published two large volumes entitled (translated) "Material for the History of Entomology before Linné." Volume 1 was published in 1928, and Volume 2 in 1929. The work is one of extreme interest, and Doctor Bodenheimer has evidently spent a great deal of time and a great deal of patient research. Volume 1 contains 498 very large octavo pages and is illustrated by 155 text figures and 24 plates. Volume 2 has 436 pages, 100 text figures, and 4 plates. In Volume 1 he speaks especially of agricultural entomology known to the Romans and to the Arabs, and also of agricultural entomology as

treated by Aldrovandus, Crescentius, and Mouffet. In the second volume, his opening section is devoted to economic entomology, and he devotes 76 pages to this subject. Of these 76 pages, however, 10 are devoted to silk culture and 10 to bee culture. The greatest space is devoted to locust years, and about 25 pages are given to this subject. The years of great locust invasion for many countries are given. The earliest of the writers on agricultural entomology mentioned especially is Johann Colerus whose "Haushaltsbuch" was published about 1590. This writer was born in Silesia and died in Mecklenburg in 1639. He seems to have written about a number of garden insects and to have mentioned remedies for chronological use in the garden, something on the style of one of our farmers' almanacs.

These volumes by Doctor Bodenheimer are full of important information. He has done an enormous amount of painstaking and valuable work. He has done it so thoroughly that probably no writer will for many years treat of early entomology without using this remarkable work. It has not yet been translated into English. I hope that some one will make such a translation and publish it before many years. In the meantime, those who have difficulty with the German language will do well to consult the rather full reviews published in *Nature*, both written by Dr. F. A. Dixey. The first volume is reviewed in *Nature* for June 22, 1929, pp. 935-937. The second volume is reviewed in *Nature* for March 29, 1930, pp. 483-485.

In the second volume Doctor Bodenheimer calls especial attention to a very early book published in England. It is entitled "A Treatise of Buggs," by John Southall, and it was published in 1730. Bodenheimer devotes considerable space to a description of this little book, a copy of which is, fortunately, in the Congressional Library in Washington, where I have been able to consult it. The author is described as "Maker of the Nonpariel Liquor for Destroying Buggs and Nits." His story is that while living in the West Indies he learned of a compound for destroying bugs from an ancient Jamaican negro. Of course the bugs referred to are true bedbugs (*Cimex lectularius*). A good description and figures of the insect are given with an account of its development. The author states that he will use his remedy for people at the rate of ten shillings and six pence for a certain type of bedstead and five shillings for ordinary bedsteads without furniture. The value of the book consists solely in its accurate plate and its account of the development of the insect.

Dr. Walther Horn, in a paper read at the Third International Congress of Entomology at Zurich, showed that in the old times of the

Greeks very careful and very strong proscriptions by law existed against locusts at Lemnos, in Syria, and even in Cyrenaica.

But after all, these early publications were very elementary. They did not foreshadow in the least the development of the true economic entomology. They showed something about the ravages of insects, and, where they had remedies in mind, they were immediate remedies. I have been delighted, therefore, to find in W. M. Wheeler's remarkable chapter on "The Life and Work of Réaumur," published in his book on "Natural History of Ants" (1926), a paragraph about that wonderful Frenchman in which he shows that what interested Réaumur most in the insects was their industries, their "*genie*," and that he demonstrated through his work "that it is only through such studies [as Réaumur's] that we can control and utilize these diminutive engineers to our own advantage. His insistence on this matter is so obvious that he may truly be said to be the creator of economic entomology." This is going very far, but if Réaumur was not the creator of economic entomology, he was apparently at least the first man to show, what is becoming so obvious today, that we cannot control insects until we know all about them. Wheeler shows in a footnote that J. Rabaud is also of his opinion, and he quotes from the latter as follows: "We must also maintain that Réaumur was the first to demonstrate the practical usefulness of the study of insects. Certain caterpillars, for example, which devour the leaves of cabbages, flee the light and bury themselves in the ground during the day. The depredations are noticed, but their authors will remain unknown as long as this peculiarity of their mode of life is unknown."

The work of Réaumur was not only well known but was greatly admired by the English authors Kirby and Spence, who also evidently knew very well the work of other writers on entomology, and, possibly influenced by the work of Réaumur, there were several of them who held the same views as to the economic importance of the study of insects. The four-volume work by these English authors, entitled "An Introduction to Entomology," the first volume of which was published in 1815, is well known to all entomologists; but the man is rare who has of recent years read the wise words of these men. No one knows which parts of this great work were written by Kirby and which by Spence. They refused to differentiate these portions, and each one is supposed to have shared in the production of each chapter. But the old masterpiece is full of wise arguments concerning the importance of the study of insects from all points of view, perhaps especially from the economic point. They knew the views of Réaumur and the small group of writers that followed him,

and they elaborated these views in the most convincing way. Many important points were brought out by them that hung around the consideration of the danger from insects. They seem, for instance, to have elaborated at this early date the "balance of nature" idea which has become so important in discussions of late years either by the name just given in quotation marks or by the somewhat wiser sounding "biocoenotic equilibrium." To whoever may be reading these words I suggest that he will probably improve his time and enjoy himself much better if he will lay this aside and take up the first volume of Kirby and Spence.

THE PHYLLOXERA OF THE GRAPE AND ITS INFLUENCE ON EUROPEAN APPLIED ENTOMOLOGY

The grapevine Phylloxera occurs upon the roots of the grape in one form, and in galls on the leaves in another form. It is an insect apparently of American origin. It was first described in 1854 by Asa Fitch from the gall form on the leaves, and he named it *Pemphigus vitifolii*.

It seems probable that it made its first appearance in France in 1863, but its first appearance is generally attributed to 1867. In England it was found at Hammersmith near London in 1863, and was described by Westwood as *Peritymbia vitisana*.

In 1868 a French commission was appointed to investigate the trouble, which was thought to be a disease. J. E. Planchon was one of the commissioners. He found the insect and gave it the provisional name of *Rhizaphis vastatrix*. Specimens were sent to Signoret in Paris, who decided that the insect belonged to the genus Phylloxera.

In the meantime Westwood had continued his observations in England and had studied insects both from France and the United States. Valéry Mayet states that the English author announced at the meeting of the Entomological Society of London, February 1, 1869, that he recognized the identity of the American and the French insects. It is interesting to note, however, that the published proceedings of the London Society of that date do not report Westwood as having made this statement.

It is perfectly obvious that the grapevine Phylloxera should be known as *Phylloxera vitifolii* (Fitch). Nevertheless, the name *Phylloxera vastatrix* given it by Planchon 14 years after Fitch's description was the one used in all of the literature for many years. Valéry Mayet justifies his own use of the latter name on the ground of the

admirably descriptive term *vastatrix* and "usage, that grand master * * * has consecrated the cognomen repeated by the press of the entire world."

In 1870, Riley in Missouri established the identity of the European and American forms, and the identity of the root form and the leaf form. He confirmed his conclusions in a journey to France in 1871.

The most important observations on the life history of the Phylloxera were carried on probably by Balbiani and Cornu.

The spread of the plague was rapid. Its original home was obviously the United States east of the Rocky Mountains. About 1869 it was strongly established in the Southeast and Southwest of France. The two points of introduction were at Roquemaure and at Floirac, both shipments coming in from Bordeaux. By 1878 practically the whole of France was involved, and Corsica as well. Later Algeria was invaded.

To independent introduction on American plants was probably due the appearance of the insect in Portugal and in Spain. It was first recognized in Switzerland in 1874, and about the same time it appeared at points in Germany. In Austria and Hungary it was probably introduced from America in 1868. In Italy it was first noticed in 1879. In the Crimea and in Caucasia, the principal regions in Russia for vine culture, it appeared in 1880; and in 1886 it was apparently introduced into Bessarabia by the introduction of root stock from Erfurt, Germany. The Danube provinces, Rumania, Moldavia, European and Asiatic Turkey, in the period between 1883 and 1885, were found to have been invaded.

Australia was found to have introduced the plague as early as 1875.

Although not native to the country beyond the Rocky Mountains, and although grape growing, and especially the cultivation of the European vine (*Vitis vinifera*), had become a great industry in California, nevertheless, by commerce in root stocks, the Phylloxera was introduced and established in that State apparently some time in the 1890's.

The alarm caused in France by the Phylloxera is difficult to exaggerate. It had many disastrous effects. Aside from the absolute destruction of the vines as early as 1884 over a territory comprising 1,200,000 hectares, a monetary damage which was estimated at 7,200,000,000 francs, there must be added the consequent necessary importation of wine and of dried grapes to make wine, which cost France over 2,800,000,000 francs, and the total loss by 1884 of ten billion francs (two billion dollars).

That this catastrophe should have occurred just when it did was particularly insupportable. The Franco-German War began in 1870, monopolized the whole strength of the French Empire, and left the nation at its conclusion enfeebled to such an extent and burdened with such a debt that this added crippled condition of one of her most flourishing industries, was crushing.

The whole world marveled at the rapidity of France's recuperation. Enormous indemnity to Prussia was paid in a marvelously short time, and it is safe to say that the discovery of the means of repairing the damage done by the *Phylloxera* and of restoring French wine culture to its former prosperous condition helped greatly not only to pay the enormous debt but to restore the confidence of the people, politically experimenting as they were with their new republican form of government.

When we consider the waste occasioned by the very great number of unfounded remedial plans that were tried and the overwhelming number of suggestions that came in from ignorant people, all of which had to be passed upon, it becomes a question as to whether the French government was wise in offering large prizes as it did for the discovery of a competent remedy. One takes this view particularly when he remembers how simply the whole matter was solved.

It seems that Monsieur Laliman of Bordeaux was the first to point out the resistance of the American vines to the *Phylloxera* in France. In 1862 rooted American grape-vines had been introduced at several places in Europe. The idea of grafting occurred to Monsieur Gaston Bazille, President of the Society of Agriculture of Herault. In 1871 he succeeded in such grafting, and at the same time Planchon and Lichenstein achieved success in the same effort. Riley in America had pointed out the resistance of the American vines; and in 1872 and 1873 vines chosen by Riley were sent to France. In the latter year Planchon was sent to America to study the American vines in their indigenous habitat.

From that time on, the course was plain. Gradually the old roots of the European vines were replaced by American roots upon which the European vine was grafted, and French vine-culture was on the high road to reestablishment. The same process was adopted in other countries, and the *Phylloxera* scare virtually became a thing of the past.

France at least has shown herself very grateful to the United States for its assistance in bringing about this wonderful result. Riley was decorated by the French government, and there was erected at the great School of Viticulture at Montpellier a very beautiful

marble statuary group. The latter represents an old, decrepit, emaciated, nearly nude female showing illness and despair in her attitude and in every feature, but supported by another female figure, also nearly nude, but young, strong, full of vigor and life, and very beautiful. The group symbolizes the American vine coming to the rescue of the French vine. On one of my visits to Montpellier, Monsieur Havas, the long-time Director of the Viticultural School, remarked to me, "The symbolism is very beautiful and very apt, but whoever saw a French woman as homely as that?!"

We have mentioned the waste of time in France in considering a very great number of unfounded remedial plans, and have suggested that perhaps it was not wise of the French government to offer large prizes; and on this subject we wish to say a little more.

On a smaller scale of course, this prize offering for remedies has been tried elsewhere; in fact, the State of Texas tried it 30 years ago in search of a competent remedy for the cotton boll weevil. The prize offered was \$50,000, and the State officers were overwhelmed by applicants who suggested plans of which the majority were nonsensical but of which many needed careful test by conscientious and trained people. It is not surprising that the offer was withdrawn in a year or two, nor is it perhaps surprising that for many years afterwards the idea that a prize had been offered drifted about the world and the officials of the State of Texas and of the United States Government were pestered by a very great number of applicants. So far as I know, not a single sound, practical idea was sent in.

The experience of France was very well described by J. E. Planchon in an article in the *Revue des Deux-Mondes* of January 15, 1887, as quoted in Prof. Valéry Mayet's book "*Les Insectes de la Vigne*" in which Valéry Mayet himself says, "What tides of ink, what floods of ineptitudes, what foolish suggestions, have been inspired by the prize of 300,000 francs!" Planchon says:

To fish out a sound idea in this torrent of fantastic lucubrations, one must impose upon himself the task of removing floods of ignorance. It will be necessary to speak of the toad, living under the soil to attract to himself the venom with which the diseased vine is affected; it is necessary to remember that the sick vine should be watered with white wine or with an emollient mixture of which mallow is the principal ingredient. In the deluge of recommendations the greater part are from those who confound the *Phylloxera* and the *Oidium* fungus or who have never seen either of these parasitic diseases. The stripping from this dossier of all the foolish things gives one a very sorry opinion of the knowledge of the great public in scientific matters. These suggestions come from all social ranks and from all corners of Europe. Those most forcefully recommended to the Ministry of Agriculture are usually the most ignorant. The

most tenacious are those men who are possessed with an idea which they urge to the limit of folly. Happily, as observation and experiment press more closely upon the problem, the dreamers pass out, idle discussions give place to the study of facts, useful research concentrates upon points still obscure, leaving in full light those that science admits as sufficiently plain.

Present-day workers in economic entomology, especially those who have been connected with any of the major projects such as the cotton boll weevil, the San Jose scale, the gipsy moth, the European corn borer, or the Japanese beetle, will recognize from this quotation that the same sort of thing has occurred over and over again and that subjects of this kind must be studied by competent men who must pay little attention to the suggestions of the obviously ill-informed.

I have given so much space to this consideration of the *Phylloxera* in Europe for the reason that serious work in economic entomology, supported by Federal appropriations, originated in many European countries as the result of this extraordinary check to viticulture by the pest introduced from North America. We have been coming to believe in the United States that such scourges, even though they have caused enormous loss for a while, are really blessings in disguise, since they have added greatly to our knowledge of the best methods of fighting insects, have shown the people the faulty ways in which they have been carrying on the industries affected, and have awakened the people to the necessity for scientific work on a large scale.

In this same way the *Phylloxera* experience was probably in the long run good for most of the European countries. As an example, the *Phylloxera* Commission in Hungary, headed by Dr. G. Horvath, was, when the *Phylloxera* problem was solved, turned into a permanent service for the study of injurious insects, with J. Jablonowski at its head, Horvath himself retiring to his technical work in the Hungarian National Museum. In the same way, other European services were started.

GREAT BRITAIN

England has been a center of entomological studies for very many years. The Entomological Society of London is one of the oldest of the world's entomological societies that are still in existence. But for a hundred years or more before this Society took form there were entomologists who were greatly interested in insects, and there were publications about insects in England that took a very high rank. As a matter of fact the Society of Aurelians was in existence in the eighteenth century and held its meetings at the Swan Tavern in Change Alley. Its collections and books were burned in the great fire

of March 26, 1748. In 1780 "The Society of Entomologists of London" was formed, but it had no long existence. In 1801 "The Aurelian Society" was formed, and out of it grew the Entomological Society of London. It is worth while to quote the objects of the Aurelian Society, since they indicate an appreciation of the injuries done by insects and a desire to counteract them:

To form a complete and standard cabinet of the entomological productions of Great Britain:—To ascertain their names, uses, and distinctions:—the places and times of their appearance, food, economy, and peculiarities:—and to point out to the public the readiest and most desirable methods of destroying such as possess properties that are inimical to the welfare of mankind.

In 1812 a single volume was published as Volume 1 of the Transactions of the Entomological Society of London, but the present Entomological Society of London dates from 1832. It brought together a number of admirable men, and this number increased rapidly during the rest of the century. These men studied with great care practically all of the insects of Great Britain. The Irishman, A. H. Haliday, and the Scotchman, Andrew Murray, were included in the long list of British entomologists whose researches spread out far beyond the insect fauna of the British Isles and resulted in the publication of very many volumes on the classification of insects and on other aspects of entomological science.

Probably no other language is quite as fortunate as English in the possession of two such comprehensive and inspiring works as Prof. J. O. Westwood's "An Introduction to the Modern Classification of Insects Founded on the Natural Habits and Corresponding Organization of the Different Families," published in London in two volumes in 1839 and 1840, and the much later work, also in two volumes, by Dr. David Sharp, published in 1895 and 1899 as Volumes 5 and 6 of "The Cambridge Natural History." Both Westwood and Sharp were men who had been students of insects all their lives and who had published very many important papers on different aspects of entomology before bringing out these large works. Both works may be said to be epoch-making, and each author summarized in a most admirable way not only the results of his own long labors but the status of entomological science in general at the period at which they wrote.

And now to go into strictly *applied* entomology: One of the early practical books was published in London in 1829 and was written by Joshua Major, a landscape gardener. The title of the book is "A Treatise on the Insects Most Prevalent on Fruit Trees and Garden Produce, Giving an Account of the Different States They Pass

Through, the Depredations They Commit, and Recipes for Their Destruction. Including the Recipes of Various Authors, with Remarks on Their Utility; also a Few Hints on the Causes and Treatment of Mildew and Canker on Fruit Trees and Cucumbers, etc." In his introduction the writer is apologetic, but insists on the importance of the subject; acknowledges that he has not been in the habit of writing but hopes that the usefulness of the information "will apologize for the defects of style and composition." It occurs to us that he perhaps ought to have apologized for the length of the title. The different insects are considered under their host plants, and the remedies are described at length. He takes up one proposed remedy after another and gives the result of his experience. As would naturally be supposed, they are gardeners' remedies. The book is worthless from the present standpoint, but is interesting and curious as indicating many of the remedies used by gardeners at that time, the majority of which were based upon erroneous ideas as to the biology of the insects.

In 1860, John Curtis' famous volume "Farm Insects" was published by Blackie & Son, Glasgow, Edinburgh and London. Nothing quite comparable to this book had been published before in any language. It is difficult to see why John Curtis made such a mark in economic entomology. He was not a farmer; he was not trained scientifically, but was simply apparently a born naturalist who loved insects and who excelled in delineating them.

Curtis was born in Norwich in 1791, and died in London (I think) October 6, 1862. From the age of four, he loved plants and animals, and began a collection of butterflies. At 16, he was placed in the office of a Solicitor, and at 18 he left that office. He became acquainted with Mr. Simeon Wilkin, the possessor of a fine collection of insects, and resided with him as curator, meeting from then on most of the London entomologists. He became a very competent draughtsman, and in 1819 came to London and was employed as an entomological draughtsman. He began to illustrate the genera of British insects for Stephens, and continued in this work for 16 years. His drawings are the most perfect and beautiful ones that had ever been seen by his colleagues. During this time he began to write for the "Gardener's Chronicle" on insects injurious to agriculture, and in this famous journal he published 120 papers signed "Ruricola." He also published, in the Journal of the Royal Agricultural Society, a series of "Reports on the Economy of Insects Obnoxious to the Farmer and Gardener," and on these reports was based his famous volume.

The influence of this book on Walsh, Fitch, and Riley in this country was very great. I believe that Riley got some of his earliest and soundest ideas here. The combination of Curtis' book and his own personal acquaintance with Walsh gave Riley a great start.

Curtis' book was far ahead of any written up to that time in any language. It went way beyond Harris' "Insects Injurious to Vegetation" in this country in its practical features.

It is extremely interesting, after the lapse of more than 75 years, and after the enormous growth in our knowledge of insects from a practical point of view, and the tremendous advances in methods of study and in the all-round scientific requirements of the modern entomologist, to examine Curtis' book and see how unerringly he pointed out a lot of basic things.

For example, in his introduction (written in 1857) he points out very plainly a fact which in later years I have had difficulty in presenting in a perfectly clear way to administrative officers and legislative committees, namely the importance to the practical man and to the economic entomologist of the museum worker, the desk naturalist, the taxonomist. Read the following:

In perusing this volume, the reader who wishes to make himself acquainted with the economy both of his insect friends and enemies, whose histories are the subject of the following chapters, ought not to pass over as useless the descriptions of the various species. It is a great mistake to suppose that scientific descriptions and correct nomenclature ought to be employed for the use of those only who are specially engaged in the study of natural history. If insects be not thus accurately and scientifically described, and their names carefully learned, the facts noticed by practical observers are generally worthless, and may tend to mislead, by the confusion of one species with another, and the consequent adoption of improper remedies. It is thus that I have found, in my extensive reading on these subjects, that a very large amount of the information given by practical agriculturists and gardeners, has proved valueless in cases where, if the particular species alluded to could only have been identified, it would have been of great value in furthering subsequent investigations.

Writing from the modern standpoint, one is especially impressed by the plan which Curtis adopted in his "Farm Insects," of introducing a summary at the end of each chapter, in which he displayed in short, two-or-three-line paragraphs the facts brought out in the chapter. This general plan was not adopted at all generally by scientific writers until very many years later. It was unfortunate that this general plan was not carried out systematically by Curtis throughout the entire volume, but in the earlier chapters the plan plainly proves its enormous advantages.

Several points suggest themselves in going through these summaries. The most important is that variations in agricultural prac-

tice were insisted upon by Curtis as a means of avoiding insect damage or lessening it. This is a fundamental idea which received mature and careful consideration by American economic entomologists only at a much later date.

Curtis was also one of the early writers accurately to define the situation as regards natural control. The following words occur on page 23:

* * * for it is a wise dispensation of Providence to keep every animal in check by some other that is either more powerful or more sagacious than itself; and this counteracting effect is produced in a degree equal, or eventually superior to the noxious animal, so that in a greater or less space of time the destructive power may be rendered no longer formidable, or be absolutely annihilated by the attacks of its parasites. This natural process, though never failing, is often too slow in its operation to secure immediate relief; the farmer must, therefore, devise means, if possible, for the more speedy destruction of the enemy.

The final sentence in this quotation contains an idea which I have myself frequently in late years put into words when referring to biological control, without, however, the slightest idea that Curtis had written it prior to 1860.

The volume "Farm Insects" is a collection of the articles that Curtis had published in the *Gardener's Chronicle* and in the *Journal of the Royal Agricultural Society*. It was chiefly on account of the value of these articles that he was awarded a pension from the Civil List. He died October 6, 1862. Some time before his death he suffered complete loss of sight. The government, with a care unknown in this country, augmented his pension when this occurred.

It is generally agreed that "Farm Insects" is the most beautifully illustrated standard work in English on the subject down to the time of the perfection of the photo-engraving process.

Great Britain, however, with the exception of this great work by John Curtis, did practically no important work in economic entomology before 1880. Professor Westwood, it is true, had written many short articles for the agricultural press concerning individual injurious insects, and the farmers, and especially the gardeners, seemed to have evolved methods of culture that afforded their crops measurable protection from insect attacks to a point at least where the simplest hand operations were all that were necessary as a general rule. There was not, however, any especial Government appropriation for work in economic entomology. In 1885 Mr. Charles Whitehead suggested to the Lords of the Committee of Council for Agriculture that it would be valuable to publish reports on insects injurious to various farm crops. He prepared, and the Council published, a series of

four reports, and in 1886 he was formally appointed Agricultural Adviser, and published another report. In 1889 the Board of Agriculture was formed, and Mr. Whitehead was retained as Technical Adviser and prepared several annual reports and a number of leaflets and special bulletins.¹ There was no specific law authorizing the expenditure for this work, but he continued it on an annual compensation of 250 pounds for many years.

In the meantime a wealthy lady, Miss Eleanor A. Ormerod, who had long been interested in entomology and whose brother Edward, a physician, had written the monograph, "The British Social Wasps," was appointed Honorary Consulting Entomologist to the Royal Agricultural Society in 1877. She conducted the correspondence of the Society on the subject of injurious insects and published at her own expense a series of annual reports, 17 in number, which contributed very largely to the diffusion of knowledge concerning injurious insects among the farming classes. She had a most conservative class of people to deal with, and encountered many obstacles. She showed herself possessed of great enthusiasm and unlimited perseverance. She studied many of the English crops *de novo*; she popularized the work of other English entomologists, and made accessible to the farmers the work of John Curtis and Professor Westwood. Her papers were all well illustrated, and her sister, Miss Georgina Ormerod, drew many of her figures. Moreover, she adopted and strongly advocated measures found to be successful in other countries, especially in America. She conducted a very large correspondence with entomologists in other parts of the world, perhaps most voluminously with Dr. James Fletcher and Dr. C. J. S. Bethune of Canada, and Professor Riley and myself in the United States. Her hardest struggle in England was to introduce the use of Paris green. English gardeners and orchardists and the authorities were all against her. But she finally succeeded, and always considered it one of her greatest triumphs.

During this period also she published a large Manual of Injurious Insects (1892). It contained 230 pages and was illustrated by 160 figures. She also published in 1898 an excellent volume entitled "Handbook of Insects Injurious to Orchard and Bush Fruits." This book covered 286 pages and was very well illustrated. She also published smaller works relating to the Hessian fly, sugar cane insects, and the injurious insects of South Africa. Miss Ormerod died in

¹ Miss Ormerod, mentioned later, helped him in this work. This help was not acknowledged in print, but is mentioned in Miss Ormerod's published correspondence with Dr. James Fletcher.

1901, and her partly completed autobiography was extended and published under the editorship of Prof. Robert Wallace. It is a very interesting volume, and includes extracts from her correspondence with many scientific men.¹

In 1894 the office of Honorary Consulting Entomologist of the Royal Agricultural Society, that she had held for so many years, was changed to Consulting Entomologist, or rather Zoologist, and the position was made a salaried one. Mr. Cecil Warburton received the appointment.

It should be stated here that in 1877 a strong effort had been made to secure the appointment of a Government entomologist. A conference was held at the Society of Arts which was largely attended and was presided over by the Duke of Buccleuch. The most important paper was read by Andrew Murray, resolutions endorsing the proposition were passed, and the Government was urged to take up the subject at once. However, no action on the part of the Government followed.

Mr. Warburton became connected with Cambridge University, and for many years was employed by the Board of Agriculture at an annual salary of 200 pounds. He advised in matters relating to entomology, and published a certain number of good reports.

Later, economic work was taken up at the University of Birmingham by Walter E. Collinge and at the Southeastern Agricultural College at Wye by F. V. Theobald. Mr. Collinge wrote some important papers; and Professor Theobald before the end of the last century had begun the publication, in the journal of his College, of a series of important articles on agricultural entomology. These appeared at intervals of approximately six months. He also prepared an exhibit of the injurious insects of England for the British Museum of Natural History, but he was not permitted to expand it as he would have liked, which seems a great pity.

¹ Miss Ormerod was a most charitable person. She once sent me a large sum of money for the relief of the suffering at the time of the Johnstown flood (May, 1889). What I wish especially to record here, however, is the fact that in April, 1900, the University of Edinburgh gave her the honorary LL. D. I think this was the first time that this degree was conferred by Edinburgh upon a woman. At the ceremony (as she wrote me on April 30, 1900) she sat next to Mr. Choate, then Ambassador from the United States to England. Miss Ormerod wrote, "As I took my seat by him after receiving the degree, he gently whispered, 'I congratulate you; you did it splendidly,' and I thought it very interesting that my first congratulation should be so kindly given me by the Ambassador of the greatly advanced country to which I am so indebted for help in my work."

Immediately after the discovery of the carriage of malaria by mosquitoes by Ross in 1898, Professor Theobald was commissioned by the Royal Society to prepare a monograph of the mosquitoes of the world, which was published by the British Museum in several volumes between 1901 and 1905—a most notable piece of work and of the very greatest use in medical entomology.

Prof. L. C. Miall's little book published in 1902 in London and entitled "Injurious and Useful Insects—An Introduction to the Study of Entomology" should not be overlooked. It is a duodecimo of 250-odd pages, well illustrated, and includes in its anatomical and classificatory features information necessary to the true student of applied entomology. Professor Miall was a keen student, but by no means to be considered as an economic entomologist. The brief chapter on remedies is for the most part drawn from the publications of the United States Department of Agriculture.

In 1912 an Imperial Bureau of Entomology was formed in London. This Bureau has been of immense service to the economic entomologists of the British Empire, and in fact to the economic entomologists of all countries. With its headquarters at the British Museum of Natural History, it is able to secure identifications of injurious insects sent in by the colonial and dominion entomologists. But its greatest service to economic entomology has been in the establishment of a Review of Applied Entomology published each month in two parts, the one Agricultural Entomology, and the other Medical and Veterinary Entomology. This Review is a great boon to all English-speaking entomologists. Its staff of compilers is able to read and digest articles in many languages unknown to the average worker.

An event almost concurrent with the founding of the Imperial Bureau of Entomology has much interest. Lord Cromer, on his return from his wonderfully successful administration of affairs in Egypt, was made the Chairman of the Central Africa Research Committee. Andrew Carnegie, being in London, met Lord Cromer and inquired about his new work. His Lordship replied that it was broadly planned and promised great results. In the study of the agricultural resources of Africa, however, it had been found that England did not have the men to handle the matter of insect damage to the crops which they hoped to grow in many parts of that fertile continent. "We have not," he is reported to have said, "any men trained in work of this kind, such as you have in such numbers in America." Mr. Carnegie at once replied that he would gladly pay the expenses of a number of young Englishmen who should be selected to go to the United States and study American methods. This proposition was

accepted, and it was arranged that three selected Englishmen—one from a Scottish university, one from either Oxford or Cambridge, and the third from one of the agricultural or industrial colleges—should be sent to America for one or more years, and that this sending should be repeated as often as desirable.

In this way was begun one of Carnegie's extremely useful philanthropic measures which is not generally known and of which he never made the slightest display. Seven of these men came to the United States prior to the outbreak of the World War, and five others came during the early part of the war. After Mr. Carnegie's death, some funds were remaining in England for this purpose, and two men were sent from England, two from South Africa and two from Canada.

It is certain that this action on Mr. Carnegie's part has already resulted in great good. Unfortunately, three of the men who came over before the war have died—Andrew Rutherford in Ceylon, C. W. Mason in Africa, and G. D. Grosvenor in England. All were men of very great promise. Others have been sent out to colonial possessions and are doing excellent work. It will be well worth while here to record these so-called Carnegie Students, as it will be the first published record of this one of Andrew Carnegie's wise acts. Each of them spent at least a year in the United States, some of them going to a university over here for part of the time, but most of them studying in the laboratories of the Bureau of Entomology both in Washington and in the field. They were as follows:

- Andrew Rutherford, January 30, 1911, Scotland.
- Edgar H. Strickland, January 30, 1911, Kent, England.
- G. D. Grosvenor, 1911, Cambridge, England.
- Malcolm E. MacGregor, December 10, 1913, Cambridge, England.
- C. W. Mason, December 10, 1913, Wye College, England.
- Archibald H. Ritchie, January 8, 1914, Edinburgh and Glasgow, Scotland.
- Edward R. Speyer, July 20, 1914, Oxford, England.
- Ernest Hargreaves, September 3, 1914, Imperial College of Science, London.
- George H. Corbett, September 15, 1914, Trowbridge, England.
- C. B. Williams, September 30, 1914, John Innes Horticultural Institution, England.
- H. G. Champion, November 4, 1914, India Forest Service.
- F. W. Dry, February 27, 1915, Leeds University, England.
- F. O. Bain, October 4, 1920, Kilmarnock, Scotland.
- J. C. M. Gardner, December 4, 1921, Cambridge, England.
- R. O. Wahl, February 16, 1922, Middelberg School of Agriculture, South Africa.
- A. E. Lundie, October, 1921, South Africa.

There were also two Carnegie Students from Canada after the war: W. H. Brittain, of Nova Scotia, and A. B. Baird.

It should be stated moreover that Mr. Carnegie's interest in this matter did not end with this sending over of the Englishmen. He paid the expenses of K. Escherich's three months of travel in this country in 1911, and those of Paul Marchal in 1913 for a journey of the same length. While none of the Englishmen have published specific accounts of their work in the United States, both Escherich and Marchal published important books. That of Escherich's is entitled "*Die angewandte Entomologie in den Vereinigten Staten.*" It is a fully illustrated, royal octavo book of nearly 200 pages and was published by Paul Parey, Berlin, 1913. Marchal's book is even larger. It is entitled "*Les Sciences biologiques Appliquées à l'Agriculture aux Etats-Unis.*" It is also a fully illustrated volume, and covers nearly 400 pages of royal octavo. It was originally published as a part of the *Annales des Epiphyties*, Volume 3, Paris, 1916. The influence of both of these books in Europe and other parts of the world has been very great.

It might be of interest to relate an incident apropos to Carnegie's assent to my proposition that he make it possible for Marchal to come over. In France, in the summer of 1912, I asked Marchal whether he would like to visit America if I could arrange the financial side. He said yes; and on my return I wrote to Mr. Carnegie and asked him if he would pay the distinguished Frenchman's expenses. He wrote me a characteristically brief reply in the following words: "Certainly. How much?" I answered that the three months' trip would probably cost about a thousand dollars but that, in order to make it perfectly safe, he might send me his check for twelve hundred. I do not know whether there was anything characteristically Scotch in his action, but he split the difference and sent me his check for eleven hundred dollars!

The remarkable work that has been done in the British colonies and dominions will be treated rather specifically in other parts of this volume, but, since we are considering Great Britain here and as very many of the workers in the dominions and colonies have come from the British Isles, this in an appropriate place to pay general tribute to their competence and to express my admiration for the wonderful work they have done. During the last 15 or 20 years many of them have passed through Washington, all having come to the United States to study American methods in insect warfare. I remember very well the visits of the following:

W. W. Frogatt, New South Wales.

T. F. Dryer, South Africa.

T. J. Anderson, British East Africa.

F. W. Urich, Trinidad.
G. E. Bodkin, British Guiana.
Henry Tryon, Queensland.
T. Harvey Johnston, Queensland.
Robert Veitch, Fiji Islands.
C. P. Lounsbury, South Africa.
H. A. Ballou, Barbados.
H. Maxwell Lefroy, South Kensington, England.
R. J. Tillyard, New Zealand.
C. H. Gowdey, Jamaica.
Philip Buckle, Armstrong College, England.
A. J. Nicholson, University of Sydney, Australia.
H. Hargreaves, Uganda.
W. F. Schlupp, South Africa.
G. S. Cotterel, West Africa.
J. G. Myers, New Zealand.
A. D. Imms, Rothamsted Station, England.
Alan P. Dodd, Queensland.
H. Bennett Johnston, Sudan.
L. F. Hitchcock, Australia.
D. Morland, Rothamsted Station, England.
Stanley Garthside, Sydney, N. S. W.
Karl Jordan, Tring, England.
F. G. Holdaway, Australia.
W. H. Thorpe, Cambridge, England.
F. P. Jepson, Ceylon.
David Miller, New Zealand.

The Entomological Research Committee (Tropical Africa) was appointed by the Colonial Secretary, with Lord Cromer at its head, as early as 1909. It soon began to publish, under the title *Bulletin of Entomological Research*, the results of some of the best research work on agricultural and medical entomology. Volume 1 bears the date 1910-11. After the founding of the Imperial Bureau of Entomology in 1912, its imprint took the place of that of the Entomological Research Committee, and the *Bulletin of Entomological Research* has been published steadily ever since. It contains articles of the highest value, and it goes into the problems of applied entomology from every point of view. In a way, it takes the place of the *Journal of Economic Entomology* and the *Annals of the Entomological Society of America*, and every worker in any of the broader aspects of economic entomology, no matter where situated, should have access to this important work.

England has, in fact, become one of the world centers of interest in economic entomology. H. Maxwell Lefroy, after some experience in the West Indies and a longer period of productive work in India,

was appointed Lecturer on Entomology at the Imperial College of Science in London in 1912. He was an energetic, insistent, and forceful man, with strong individualistic ideas. He was fond of lecturing on the subject of "The Training of an Economic Entomologist." In these talks he told some very pertinent truths about the difficulties of an entomologist's tasks, especially in the tropical colonies, based upon his own long experience. He taught some good men and made his name well known, and might have gone far except for his death in 1925 which was caused by accidental gas poisoning in the course of some insecticidal experiments. A very sound and appreciative account of his life and work, by Dr. A. D. Imms, will be found in the *Annals of Applied Biology*, Volume 11, No. 4, pp. 548-549, November, 1925.

Economic entomology has been pushing forward with rapid strides at the old Rothamsted Experiment Station at Harpenden of late years under Dr. A. D. Imms. Doctor Imms has a large staff and they are putting out work of the highest character. Imms himself is a man of sound training, broad experience and great knowledge. His "General Text Book of Entomology," published in 1925, is an advanced and very sound volume, containing in its nearly 700 pages a vast amount of information arranged in the most practical way and accompanied by wonderfully full bibliographical lists.

F. V. Theobald still continues his instruction at the Agricultural College at Wye, and has published many important papers. The University of Cambridge broadened its Department of Zoology to include more entomology as early as 1912. One of its sound young men, G. B. Grosvenor, was sent to America as a Carnegie Student, but unfortunately died not long after his return to England. Since that time Cambridge has been devoting more and more attention to economic entomology. George H. Carpenter has returned to England from Dublin and has been stationed at the Museum in Manchester where he has been publishing several sound books on insects and has delivered some public lectures on economic entomology. In Edinburgh, R. Stewart MacDougall has been giving up-to-date lectures for many years. He has recently retired and has been succeeded by C. B. Williams. And there are other institutions and organizations that are promoting the work.

Very recently the Empire Marketing Board¹ has appropriated a

¹ This is but one of the minor activities of the Empire Marketing Board, an institution that has the broadest plans and really constitutes one of the most important developments in agricultural research in the whole world. It is stated that the dominating motive in this large enterprise is that of making the British

large sum of money for the use of the Imperial Bureau of Entomology, and with these funds a large and well equipped station for the study of the parasites of injurious insects has been established at Farnham Royal, at first with Dr. S. A. Neave in charge, and later with Dr. W. R. Thompson as Director.

J. W. Munro, a very competent man who had begun the teaching of forest entomology at Cambridge, was, on the death of Maxwell-Lefroy in 1925, appointed to take up the economic part of the latter's work at the Imperial College of Science at South Kensington.

It has been somewhat difficult for me to understand the exact relationships between the different institutions that are doing more or less work in economic entomology in England and Wales at the present time. It has been explained to me by Doctor Inms that the establishment of the phytopathological service (including agricultural entomology) for England and Wales was originally due to the passing of the Development Fund Act in 1909 which provided financial resources for a definite scheme for research and advisory work. It seems that this service is now divided into two sections—one official and one non-official. The official section is directly controlled by the Ministry of Agriculture (formerly the Board of Agriculture) and is divided into the Pathological Laboratory at Harpenden, an administrative unit in London and a staff of inspectors of about 30. The Pathological Laboratory is under a Director, Dr. J. C. F. Fryer, who is at present the official Government Entomologist, and there is a small staff of entomologists and mycologists.

The non-official section is distributed through various universities, colleges, and institutes in the country, and consists of research and advisory divisions. While financial support comes from the Government, the actual duties are carried out largely without State supervision. There are five research centers, namely the Phytopathological Research Institute attached to the Rothamsted Experimental Station, the Long Ashton Station at Bristol, the Fruit Station at East Malling, and a Lea Valley Station for glass-house crops at Cheshunt. The advisory division is located at 14 centers or provinces, each center being established at a university or agricultural college. There are thus constituted in a way 14 provincial entomologists. These appear in the published list of reporters, but they actually represent a far

Empire more self-sustaining in the matter of food stuffs, and to that end the development of an imperial consciousness and unity of effort is sought. From July, 1926, to May, 1928, the Board allotted no less than \$5,000,000 for research projects and institutions. Naturally, the results of research carried on under these funds will result in benefit to all nations.

larger body of reporters whose names are not printed. Each provincial entomologist receives regularly reports from people who correspond to the county agents in the United States and also from numerous growers, and bases his report to Doctor Fryer on the information so obtained in addition to that gained from his own personal experience.

The five research centers above named are all doing admirable work. For example, there came to me quite recently from the East Malling Station a large bundle of entomological separates in which the entomologists, A. M. Massee and W. Steer, treat of a variety of important topics.

In August, 1928, Doctor Fryer visited the Bureau in Washington and was kind enough to explain the present organization for applied entomology that exists in England, and it is partly from his explanation and partly from Doctor Imms that the preceding paragraphs have been written. Doctor Fryer, however, told me that the activities of the Royal Horticultural Society of England must not be overlooked, and fortunately I was able to consult Mr. G. Fox-Wilson who was also in Washington at the time. Both had been delegates to the Fourth International Congress of Entomology at Ithaca in August, 1928.

It seems that the Royal Horticultural Society, founded in 1805 for the encouragement of horticulture and for the dissemination of knowledge relating thereto, completed in 1915 at Wisley, Surrey, large laboratories for the housing of departments of entomology, mycology, plant physiology, and soil chemistry, these departments being organized at that time. The first entomologist appointed was the late Professor Maxwell Lefroy, who held a dual appointment with the Society and, as I have elsewhere stated, with the Imperial College of Science in London. G. Fox-Wilson was a student of Lefroy's and was his assistant at Wisley prior to the war. In August, 1915, Lefroy left to take up work in Mesopotamia, and Fox-Wilson was engaged on antimalaria measures in Egypt for the last three years of the war. In 1918 Lefroy severed his connection with the Society, and in April, 1919, Fox-Wilson was made Entomologist.

In the Society's Department of Entomology research work is carried on dealing with insect pests of horticultural plants. The laboratory also advises amateur and commercial horticulturists, tests proprietary insecticides and fumigants, and gives instruction to students in applied entomology. The course of instruction consists of elementary zoology, entomology including morphology, classification of insects, studies of the chief pests of plants, preventive and remedial

measures, legislation, etc. Advance courses in entomology are given to those students who are taking the national diploma in horticulture and the degree of bachelor of science in horticulture.

An important movement to which we have not referred was the founding in 1904 of the Association of Economic Biologists. The call for the first meeting was issued by Mr. Walter E. Collinge, of Birmingham, and the meeting was held in his rooms in the University of Birmingham on July 18. Prof. F. V. Theobald was made President of the newly founded Association. The inaugural meeting was held in London, November 8, 1904, at which papers were read and the Association was definitely started. Subsequent meetings were held from time to time at Birmingham, Liverpool, Cambridge, London, and Oxford, and the Proceedings were published. While the whole field of economic biology was covered, and while men of other specialties than economic entomology were included from the start among its members, the Association has always been thoroughly committed to applied entomology. The proceedings of the early meetings are published in separate pamphlets comprising four parts of a single volume.

In 1906 the Association began the publication of an important periodical known as *The Journal of Economic Biology*. This journal and the earlier proceedings were edited by Mr. Collinge. The Journal was succeeded in 1914 by the establishment of *The Annals of Applied Biology*, of which 16 annual volumes have been published, each volume containing four numbers, usually published in February, May, August, and November. This has always been a very noteworthy publication and has had the support of applied biologists all over the British Empire. It is beautifully done, from the printer's standpoint, at the Cambridge University Press. It is of large size and unusually well illustrated. Some very noteworthy papers on economic entomology have been published in its pages. An especially admirable feature of this publication is that, while the practical end is always in view, it presents in excellent shape the results of many basic studies, thus furnishing sound printed records which eventually may assist in practical deductions of the greatest importance. Some of the best papers published anywhere have appeared in its pages.

Scotland has had a number of very good entomologists, but in economic entomology little has been done north of the Cheviot Hills. Andrew Murray is one of the names, however, that is well known, and has been mentioned on an earlier page. R. Stewart MacDougall of recent years has been prominent through his writings and his atten-

dance at international conferences. He was for a time University Lecturer on Agricultural Entomology and Professor of Zoology and Botany in the Royal Veterinary College of Edinburgh, and held posts of that general character in the University until his retirement in 1928 when he was succeeded by C. B. Williams. Doctor MacDougall has published many articles on different topics in economic entomology in the *Journal of the Board of Agriculture* (London), in the *Transactions of the Highland and Agricultural Society of Scotland* and elsewhere. He is a very forceful and charming speaker, and his lectures at Edinburgh must surely have been productive of much good. I first met him at the conference of the Imperial Bureau of Entomology in London in 1920, and later at the Third International Congress of Entomology at Zurich in 1925, and again at the International Congress of Zoology in Budapest in 1927. I was much impressed with his personality, his broad knowledge and his very effective public discussions.

Surely Great Britain, with its present organization in England, with its Entomological Research Committee, with its *Bulletin of Entomological Research*, its *Review of Applied Entomology*, and now with the *Annals of Applied Biology* issued by the Association of Economic Biologists, stands well in the forefront of the research now going on in the world and looking to the control of injurious insects.

Added note.—We have referred in the foregoing paragraphs to the excellent books written by George H. Carpenter, and to Dr. A. D. Imms' admirable text-book. Other important books have been written of recent years. Two books, for example, we particularly mention. One is "The Principles of Insect Control," by Robert A. Wardle of the University of Manchester and Philip Buckle of the University of Durham. The other is "The Principles of Applied Entomology," by Professor Wardle. Both of these are broad, far-seeing books and are indicative of a very perfect familiarity with previous work.

During the year 1929 a somewhat less pretentious work, entitled "Agricultural Entomology," was published in London. It is by D. H. Robinson of the Harper Adams Agricultural College and S. G. Jary of the University of Reading. This is a book of some 300 pages, illustrated by 149 text figures, very many of which are entirely new.

IRELAND

To the systematic entomologist, Ireland will always be famous as the home of A. H. Haliday whose taxonomic work with the parasitic Hymenoptera was admirable. He seems to have been especially interested in the Chalcidoidea and to have worked cooperatively with

Francis Walker of the British Museum of Natural History. In fact, it is quite possible that the large amount of work done by Walker on the insects of this important and interesting complex was inspired by Haliday's investigations.

In strictly economic entomology, however, little work was done until 1890, when George H. Carpenter, a well trained biologist and entomologist of England, was appointed Consulting Entomologist to the Royal Dublin Society. As a supplement to the agricultural statistics of Ireland for the year 1889, there was published a "Special Report on Insects, Fungi, and Weeds Injurious to Farm Crops," illustrated with original drawings. The author was Robert E. Matheson, barrister at law and Secretary of the General Register Office. Mr. Carpenter helped in the entomological portions, which were largely compiled from Curtis, Miss Ormerod, and Whitehead. The six plates of illustrations are very fair, and the publication must have been a useful one.

Carpenter's first report on economic zoology was published in 1900, and a report of this character was thereafter submitted annually. These reports were published in the reports of the Council of the Royal Dublin Society, and reprints were distributed widely. At the time, Mr. Carpenter was Assistant Naturalist in the Science and Art Museum in Dublin.

In 1900 a Government Department of Agriculture and Instruction was established, and to this Department were transferred many of the scientific institutions of Dublin where biological research was carried on, including the Museum of Science and Arts and the Royal College of Science. Down to the time of this transfer, the Museum staff was in the habit of receiving and answering inquiries about injurious insects, and with the establishment of the Department the number of these inquiries increased. Popular leaflets on common insect pests were prepared for the use of farmers throughout the country.

In 1901 Carpenter was appointed Lecturer on Zoology in the Royal College of Science for Ireland, and entomology of course formed an important feature of the zoological course. In 1904 he was made a professor in the college, and good laboratory facilities and funds were placed at his disposal. He still retained the post of Consulting Entomologist to the Royal Dublin Society, which continued to publish economic proceedings and of course Carpenter's yearly reviews of the injurious animals of Ireland.

The yearly reports, issued as separates by the Royal Dublin Society, continued until 1920 and form a very important and useful series. They are well illustrated. Carpenter became interested at an early

date in the warble flies and made a series of excellent observations on the life history of these destructive enemies to live stock. He was a naturalist during his whole career in Ireland and published many technical papers including a number of especial value on the Apterygota of different parts of the world.

In 1921 Carpenter left Dublin and has since been working at Manchester, England, in the Manchester Museum, where he combines fundamental work with a certain amount of applied entomology. He has published a number of books of great importance, among them "Insect Transformation" (London, 1921), "Insects, Their Structure and Life" (London, 1924), and "The Biology of Insects" (London, 1928).

At some time during his stay in Ireland Carpenter was Professor of Zoology in the Royal College of Science, Dublin. As part of his work, he gave a course in agricultural zoology to the agricultural students of the College, and naturally the greater part of this course dealt with economic entomology. There was no section in the College dealing with entomology alone, or even with agricultural zoology alone. Shortly after Carpenter left Ireland the Royal College of Science ceased to exist as a separate institution, and the National University of Ireland took over control of all of the work that had previously been done in the College of Science. This led to the establishment of a new faculty of agriculture in the National University in 1927, and separate departments were created that had not existed previously in the College of Science. A separate Department of Agricultural Zoology was thus established. During the transition period (1923 to 1928) Mr. E. J. Sheehy, who had at one time been Carpenter's assistant, continued to give the course in agricultural zoology that had previously been given by Professor Carpenter. This was a temporary arrangement, and during that period no attention was paid to research in entomology.

Mr. J. Carroll, a young Irishman, in 1925 and 1926 had spent his time in London at the Imperial College of Science and Technology pursuing advanced study and research in entomology. In 1927 he was sent to the United States to continue these studies, and returned to Dublin after the Fourth International Congress of Entomology at Ithaca, New York in August, 1928. He was then given charge of the new Department of Agricultural Zoology. He writes me that the Department is not yet fully staffed but that it is making steady progress. His work includes a course in agricultural zoology for the agricultural students of the University, and the greater part of this course, naturally, deals with economic entomology. Most of his time is free

for research, and the problems on hand at present and those contemplated are mostly of an entomological nature. He also acts as Entomological Adviser to the Irish Free State Department of Agriculture.

FRANCE AND HER COLONIES

France has produced many very famous entomologists, and a number of great works were published in that country as early as the early part of the eighteenth century. As time went on a number of high-placed individuals took up the study of entomology, and it might almost be said to have become fashionable at one time. Cuvier and Buffon and their work excited much interest at court. Later Count Dejean, one of the generals of the first Napoleon, was a famous Coleopterist.

The French have done much in economic entomology. One of the earliest and most important of all the early papers in economic entomology was that by Henri Louis Duhamel Du Monceau, who was commissioned by the Royal Academy of Sciences in May, 1761, to investigate in Western France a severe outbreak of a grain moth, now known as the Angoumois grain moth (*Sitotroga cerealella*). An admirable investigation was made by Duhamel and his assistant, Mathieu Tillet, and the results were published in Paris in 1762, a leather-bound volume of 314 pages illustrated by three plates of admirable drawings. Mr. Perez Simmons has published a short article, praising this monographic contribution, in the *Journal of Economic Entomology* for October, 1929.

During the early part of the nineteenth century there were nine French writers on economic entomology who should be especially mentioned.

J. V. Audouin (1797-1841) was Professor of Entomology in the Museum at Paris and wrote much on anatomical and taxonomical subjects and also published many interesting biological papers. His studies of the blister-beetles were important and were summarized in his "Prodromus of a Natural, Chemical, Pharmaceutical, and Medical History of the Cantharides." In 1835 he published a note on a larva that does great damage to oat fields. He also published on the woolly root-louse of the apple and a number of short papers on insects injurious to forest trees; also on vine insects, the hair-worm, parasites of white grubs, on the diseases of the silkworm of commerce, on insects of the mulberry, and on the insects that attack wood used in building. His largest work of this character was published in 1840-42 and was entitled (translated) "History of Insects Injurious to the Vine, and Especially the *Pyralis*."

Eugene Robert, publishing between 1836 and 1847, wrote about silk culture and about insects injurious to the elms and oaks. He also wrote a paper entitled (translated) "Methods Used to Destroy Insects."

F. E. Guérin-Ménéville (1799-1874) wrote very extensively on entomology. He was, in fact, probably the most prolific of the French writers of his period. Horn and Schenkling list 406 papers by him. The character of his papers was extremely varied. He covered a very large field. He wrote many taxonomic papers on Coleoptera, and seems to have been a broad zoologist. In applied zoology, he wrote on the vine *Pyralis* as early as 1837. In 1842 he wrote about the ravages of *Elachista coffeella* in the coffee plantations of the Antilles. In view of the recent Florida outbreak of the Mediterranean fruit-fly, it is interesting to note that in 1843 he published a monograph of the genus *Ceratitis*. In 1842 he published a note on some insects injurious to wheat, rye, barley, and clover, and in 1844 on an insect that attacks the olive in south France. In 1845 he proposed that the Royal and Central Society of Agriculture should found a prize to recompense the farmers who should discover and put into practice the best means for destroying insects injurious to agriculture. Later he wrote short notes on insects affecting the vine, olive, potato, cereal crops; also on bark-beetles, insect damage to the sugar beet, the almond, and much about silkworms and their diseases. In 1848 he published an essay on useful and injurious insects (a long article) in the *Modern Encyclopaedia*. In 1850 he published a list of insects that feed on tobacco. The majority of his papers are short, but he seems to have had insect damage constantly in mind and to have continually brought notes before the Academy of Sciences on injurious insects. His later papers are concerned mainly with silk culture. He took up the question of the use of other species of silkworms, and wrote extensively about them. One of his latest papers was entitled "Insects as Injurious Animals which ought to be Destroyed and as Useful Animals that ought to be Protected and Acclimatized."

J. Macquart, who died in 1855, published mainly about Dipterous insects, but also a series of papers on the trees and shrubs of Europe and their insects and on the herbaceous plants of Europe and their insects. Doctor Boisduval has stated that Macquart introduced in these works certain insects that are found only accidentally on the plants and should not be figured among the injurious species.

J. J. B. Géhin (1816-1889) wrote mainly on Coleoptera, but published in 1857 a lengthy series of notes on the history of insects

injurious to agriculture, horticulture and silviculture in the Department of the Moselle. This publication is referred to appreciatively by Boisduval, who states that it relates principally to insects attacking fruit trees and is of great interest.

In 1840 J. A. Fonscolombe published a work entitled (translated) "Memoirs Concerning Insects Injurious to Agriculture, principally in the Department of the Midi of France."

Col. C. C. Goreau (1790-1879) was a very prolific writer and published many short papers relating to injurious insects. One of his interesting contributions was on the Diptera that mine the leaves of plants and on their parasites. He was a close observer of parasites, and he wrote concerning the species that attack the Hyponomeutas, and again, upon the ravages of *Cecidomyia tritici* and its parasites. In 1862 he published a large volume of 250 pages under the title "Injurious insects," including accounts of insects injurious to fruit trees, vegetables, cereals, and forage crops. Later two supplements to this work were published.

In 1867 Dr. J. B. A. D. Boisduval published a large book of 650 pages, with 426 excellent woodcuts, entitled (translated) "Essay on Horticultural Entomology, Comprising the History of Insects Injurious to Agriculture, with an Indication of the Best Means of Destroying Them." This book was prepared by Doctor Boisduval in order to meet the needs of a large number of members of the different horticultural societies. In the same year he started a journal called "Insectologie Agricole," treating of useful insects and their products, noxious insects and their injuries, and practical means of combating the latter. Six volumes appeared, comprising the years 1867 to 1872.

After the publication of his big book, Doctor Boisduval, greatly interested in the whole subject of the importance of insects to agriculture, and being one of the Vice-Presidents of the Horticultural Society of Paris, organized a Society for Agricultural Entomology, of which he became President. This Society organized, during the month of August, 1868, an exhibition in the Palace of Industry in the Champs Elysées illustrating the destructive and beneficial habits of the different species of insects. It was the announcement of this exhibit in the Gardeners Chronicle that induced the Royal Horticultural Society of England to have a similar collection prepared and displayed in England, and this was one of the events that helped to focus the attention of the late Miss Eleanor A. Ormerod almost exclusively on agricultural entomology.

It happened that the Maréchal Vaillant was President of the Horticultural Society of Paris at the time that Boisduval finished the prepa-

ration of his book, and the book was very properly dedicated to the Maréchal. In acknowledging this dedication with very gracefully expressed thanks, the Maréchal added the following striking and beautifully expressed paragraph:

I have deplored for a long time the ignorance of people who occupy themselves with horticulture concerning the insects that do so much harm to our gardens and with regard to those insects which are our most useful helpers. We kill them all without distinction, or we kill none at all. Precious friends or terrible enemies, it is all the same; and if there are any exceptions these are due rather to beauty of form and to brilliancy of color than to useful qualities or hoped-for help. It is time that this should stop. Our teachers in the primary schools, if they could give their scholars some notions about the insects that render so much labor useless and about the creatures which God has created to be our collaborators, would merit our gratitude. Linnaeus, I believe, once said that the object of agriculture and horticulture is to make the lives of men more easy and more agreeable. How can we reach this end if we abandon the best part of the products of the soil without struggle and without effort to all these creatures which we know only through their damage?

Prior to the publication of Doctor Boisduval's important book, a plan had been elaborated by Émile Blanchard for the preparation and publication of a large work on agricultural zoology. This was carried into effect only so far as the publication of a certain portion, namely the insects injurious to ornamental plants. This was put out in beautiful form, in quarto, and was illustrated by a series of exquisite colored plates showing the flowering plants with the insects. The bound copy of this work in the possession of the United States Department of Agriculture contains 192 pages of text and 19 plates. The writer is in doubt as to the date of publication of this volume. It is not indicated in the work itself. The British Museum Catalogue places it at 1854. Hagen's *Bibliotheca*, in the appendix, places it at 1859, but refers only to Part I with eight colored plates. Boisduval, in the introduction to the work just cited, states that Blanchard commenced the publication of the work in 1857. He writes concerning it (translated), "In 1857 M. É. Blanchard commenced the publication of his *Agricultural Zoology*, a work whose beautiful plates make us regret that other labors prevented the author from following up this enterprise." It was an ambitiously planned work, and had its author been able to follow it through it would doubtless have been a great stimulus to agricultural entomology.

In its introduction occurs a paragraph which indicates the condition of knowledge at the time of writing. It is (translated): "Each year from every part of the civilized world one hears complaints of the ravages of insects upon vegetation, of damage to the plants that

have become precious to humanity. Those who see these cruel injuries turn towards science, but so far science has remained nearly mute."

Just as in other European countries, the discovery of the grape-vine *Phylloxera* in the vineyards of France in the late 1860's resulted in a very great interest in at least one entomological problem—that is, as soon as it was discovered to be an entomological problem. Large sums of money were spent in investigations, and prizes were offered for the discovery of a remedy.

At one time, it is estimated, 2,500,000 acres of vineyards had been destroyed, and this represented an annual loss in vine products to the value of \$150,000,000. The French Government had expended up to 1895 over \$4,500,000 in its efforts to control this insect, and had remitted taxes to the amount of \$3,000,000 in addition. Hundreds of measures to control the pest were tried out. The best preventive measure was found to be the use of resistant American stocks on which to graft the European vine and the planting of vineyards in soil of almost pure sand. The most important remedies were the underground injection of bisulphid of carbon to destroy the root-lice and, where possible, the inundating of the vineyards at certain seasons of the year.

C. V. Riley, then State Entomologist of Missouri, studied the insect in its native home, and was visited by European experts, notably Monsieur Foëx of Montpellier. The combined advice of these two men resulted in the extensive importation of American root stocks into France, and largely by this method the wine industry was saved to France and to the rest of Europe. It may incidentally be mentioned that in America Riley had found a predatory mite feeding upon the root form of the *Phylloxera*, and that he sent living material to Planchon and Foëx for possible acclimatization in France. This happened to be one of the early attempts—probably the earliest—in the sending of beneficial insects to a foreign country.

A very able zoologist, Monsieur Valéry Mayet, was connected with the National Agricultural School at Montpellier and was giving instruction in economic entomology. Later he published a very important work entitled "The Insects of the Vine."

Two very suggestive papers by M. M. Girard were published in the 1870's. The one published in 1873 considered the subject of useful carnivorous insects to be introduced into gardens to protect them against destruction by injurious insects. The second of these papers, published in 1876, relates to the transfer of insects by commerce in plants. Girard, therefore, pointed out two subjects that were in later years to receive great attention in the United States as well as in other countries.

In 1893 there was established at Paris an institution called the Laboratory of Vegetable Parasitology of the Chamber of Commerce. This institution was created in the interests of agriculture, of commerce in grain and of all the agricultural interests of which the Bourse de Commerce is the center in Paris. Monsieur J. Danysz was appointed as Director, and several bulletins were published. Danysz was a great believer in the use of micro-organisms against injurious insects and other animals, and he perfected a "rat virus" which has been apparently used with some success against field mice and rats, but in entomology he seems to have accomplished little or nothing.

At this time Professor Brocchi, Professor of Zoology at the Institut Agronomique in Paris, was charged with the founding of a Department of Agricultural Zoology for the purpose of identifying insects sent in for that reason by agriculturists and of pointing out means of destroying insect pests or diminishing their ravages. For some time previously Professor Brocchi had answered questions upon economic entomology referred to him by the Ministry of Agriculture, and, as notably in the case of *Ephestia kuehniella*, upon which he published a report in the Bulletin of the Ministry of Agriculture for 1888, he made occasionally reports upon various insects.

The new Department was started in 1894, and it took the shape of the so-called Entomological Station of Paris, housed in and connected with the Agronomical Institute. The now famous entomologist, Dr. Paul Marchal, was the first holder of the directorship of this station. So thoroughly fine has been his career and so brilliant has been the work that he has turned out that I have devoted some pages to him, which will follow this general statement regarding France.

Considerably later, around this central station at Paris were grouped regional stations which were really installed in 1911 under the Mission for the Study of *Cochylis* and the Eudemis of the Grape. These stations were later made sub-permanent and extended their action beyond grape insects into the whole field of agricultural entomology. At present (1928) after several changes of location and the establishment of new stations, the organization includes, aside from the central station at Paris, regional stations near Bordeaux, near Lyons, at Rouen, at Challete-Montargis, and at Menton. The latter station was transferred at the close of 1928 to Antibes. An important center of silk culture studies has been organized at Alais. An apicultural station was started near Montpellier where broad entomological studies had been carried on under the old installation of the Mission for the Study of *Cochylis* and Eudemis, first by Valéry-Mayet already referred to, and later by F. Picard, and still later by J. Lichtenstein.

At the close of the World War the French Government appreciated the vital necessity of increasing her agricultural products, and added funds were given to the Ministry of Agriculture for expenditure along profitable lines. These regional stations in agricultural entomology resulted or were more adequately supported financially. Marchal has told me that after the war he had difficulty in finding men to place at the head of these stations, as there were practically no men trained in economic entomology in France. He had, therefore, to pick out men who could most readily acquire a proper knowledge and who had been trained scientifically as a preliminary although mainly in other directions. For example, Raymond Poutiers, who was placed in charge of the Insectarium at Menton, although he had collected Lepidoptera as a boy and was a member of the Entomological Society of France, was really a trained industrial chemist; and Robert Regnier, who was placed at the regional station at Rouen, although an entomologist as a boy, had studied especially oceanography. Both of these men, however, as well as several others, found in economic entomology a field where everything they had ever learned came into play, and were fascinated with the possibilities of the great field opened up to them.

The reputation which Doctor Marchal has made during his long term of office, largely by his discoveries in the field of pure science, has been a great impetus to the recognition of the value of economic entomology in France among scientific men in general. This reputation has become world-wide and has done much to dignify the science in the minds of thinking people.

The Agronomical Institute has completed elaborate research laboratories at Versailles and in this admirable installation economic entomology has received full consideration. Research laboratory buildings have been constructed which are quite the best in existence down to the present time. The assistant on whom Doctor Marchal relied in the planning and superintendence of this installation was Dr. B. Trouvelot. I visited the new structures in late August, 1927, and later Doctor Trouvelot received a traveling fellowship from the International Education Board and came to the United States where he spent many months, partly at Cornell University and partly in visiting field stations. He later proceeded to Hawaii, Japan, China, and India, and returned to Paris from the East. Another assistant who had for a number of years been Marchal's *chef des travaux*, P. Vayssi re, visited the United States during the summer of 1928 as a delegate from the Ministry of Agriculture to the Fourth International Congress of Entomology, and was able during his stay in this

country to visit Washington and many of the State and Federal field stations. Doctor Marchal himself visited the United States for three months in the summer of 1913. The active force in France, therefore, is not only composed of excellent men, but it has the advantage of personal knowledge on the part of two of the younger men of the present workers and the latest developments in applied entomology in North America.

In addition to the men already mentioned, Doctor Marchal has been fortunate in securing the services of F. Willaume at Paris, who has been studying especially the question of insecticides. He has also two first-class men in the persons of A. Paillot, in charge of the regional station at St. Genis-Laval, and L. Gaumont at Montargis.¹ Paillot is studying especially the diseases of insects, and Gaumont has done admirable work with the plant-lice. Still another man not yet mentioned is Prof. J. Feytaud, connected with the University at Bordeaux, who has made some capital studies and who combines his university functions with the chiefship of the regional laboratory of the Ministry of Agriculture. Mr. Poutiers, previously mentioned, has been changed from Menton to Antibes, the westernmost point in the Riviera rather than the easternmost point. He acts as a general inspector in addition to his research in applied entomology.

The first part of a practical handbook on the insect enemies of fruit trees, by H. Latière, B. Trouvelot, and F. Willaume, was published in Paris in 1928. It comprises 97 pages, 7 plates, and 206 figures; but includes only the consideration of characters, classification, and methods of observation. Later parts will evidently make this an extremely useful work.

Although as a rule scientific Frenchmen do not take readily to the English language, Marchal, Trouvelot, Vayssière, and Poutiers all speak English with facility.

We have just seen how the necessity for work in economic entomology was found to be very great at the close of the World War, on account of the absolute need of food increase for the people. We will see elsewhere how this awful war brought about increased study and attention to medical entomology; and in much earlier pages we have touched upon the influence of the war upon economic entomology even in the United States. Two French incidents may not be amiss here:

At the time when the German armies were approaching Paris, Prof. E. L. Bouvier of the Museum of Natural History hurriedly packed some of the most precious portions of the great and invalua-

¹ M. Gaumont died in October, 1929.

ble collections of insects and personally conducted them to Toulouse in the effort to save them from the pressing danger. Of course, this was not distinctly economic entomology, but it will readily be realized that the economic entomologists depend enormously upon the great collections that have been studied by the authorities on the different groups.

Another story comes from Paul Marchal, via C. P. Clausen who was in Paris during the spring and summer following the war. It seems that during the airplane and artillery bombardments of Paris in the last years of the war Marchal was rearing *Cryptolacmus montousieri*, a ladybird enemy of mealybugs, on a rather large scale. Whenever one of the bombardments was announced, or whenever the approach of enemy planes or Zeppelins was reported, the colonies of living Coccinellids were carried to the basements underneath the buildings of the city and kept there in safety during the course of the bombardment. This is probably the only case in history where living insects were protected from destruction during a great war by human beings.

There have been in France, notably in the different universities, several men who have made important contributions to economic entomology, in addition to the men occupied at the regional laboratories under the central Ministry of Agriculture. F. Hennequey, for example, did some extraordinary work of a fundamental character with insects. Prof. A. Lecaillon at the University of Toulouse has made many careful studies of several of the important insects of the South of France.

The French colonies have had many good workers who have published articles of value. In Algeria the work of L. Trabut and M. Delassus must be referred to. An excellent report on the insects damaging cork oak in the forest of Mamora, Morocco, by J. de Lepiney, was published in Paris in 1927. In medical entomology, the Pasteur Institute of Algiers has long been a stronghold of advanced and practical research, largely conducted by the brothers Sergent. Out in the French settlements in Oceania, A. Brugiroux reported on some insects damaging crops. The French Government of Indo-China has apparently had the advice of good resident entomologists. L. Duport, before the World War, made a number of reports on the enemies of cultivated plants in the Far East. An especially full report was published in the Bulletin economique de l'Indochine for November-December, 1912, and in the following numbers. This report covers 147 pages and considers a large number of injurious insects attacking different crops. After the war, Mr. Duport again

began publishing, and the Bulletin of the Agricultural Institute of Saigon contained articles by him as well as by J. Robin and F. Vincens.

The great island of Madagascar with its dependencies has had crop troubles through insects. Years ago I had an interesting correspondence with the Rev. Paul Camboué, a missionary, who was greatly interested in insects. An important article entitled "Insect Enemies of Rice in Madagascar" (title translated), by C. Frappa, was published in 1929. It gives a summary of information on the insect enemies of standing and stored rice. It was published in the journal known as "Riz et Riziculture" (1929, No. 4).

PAUL MARCHAL

It is impossible for me adequately to express my admiration for Marchal. Following a correspondence beginning in 1894, I have known him personally since 1902, have often visited him in his laboratory and in his home, and spent the better part of three months with him traveling in the United States. Then too, in 1920 I took a long journey with him in France by automobile and by train, visiting the different stations which were operating under his general guidance. Again, in 1923 I traveled with him from Menton to Madrid and with him attended the international olive-fly conference held at that point. Later in the same season Marchal and his charming wife joined us at the International Congress of Entomology and Phytopathology in Holland.

I know nothing of Marchal's boyhood (he was born in Paris in 1865). I do not understand why we have never talked about it. Possibly because we were so much more interested in other things. When I first knew him he was probably in his early forties, a slender, active man, who might have been a writer or an artist rather than a man of science, judging from his appearance. And in fact he combines with his indefatigability as a worker and genius as a thinker the imagination of a poet and an ability for self-expression to be found as a rule only with masters of literature. Some day perhaps he will tell me what led him into science.

Marchal's early studies were carried on at the University of Paris, where he became a licentiate in science in 1883, a doctor of medicine in 1889, and a doctor of science in 1892. In 1894 he was made *Chef des Travaux* at the Entomological Station of Paris under the Ministry of Agriculture. In 1900 he was made Professor of Agricultural Zoology at the National Agronomical Institute, and in 1910 Director of the Entomological Station of Paris. His first important paper was published in 1897, "A Study of Instinct with *Cerceris ornata*," and

from that time on until he received his appointment in the Paris Entomological Station his writings related mainly to the anatomy and physiology of certain marine articulates and (toward the end of this period) to certain biological points concerning wasps.

He has always been a rather prolific writer. In 1894 and 1895 his attention was drawn to certain Dipterous enemies of the small grains, and in his studies of the parasites of these insects he became greatly interested in the biology of the parasitic Hymenoptera.

By this time he had married. I have seen a photograph of a group of workers and their families at the Marine Biological Station at Roscoff, Brittany, of which Lacaze Duthiers was the eminent Director. Marchal and his wife were in this group. I forget whether they were married at that time, or were about to be married.

At all events, when I first visited him, in the summer of 1902, he and his wife with four small children were living in a charming little villa at Fontenay-aux-Roses near Paris, and I think that his widowed mother was living with them. Shortly before this he had published his paper entitled "The Dissociation of the Egg into a Large Number of Distinct Individuals and the Evolutive Cycle of *Encyrtus fuscicollis*." I had read this paper, and had strong doubts concerning it. I had reared many egg-parasites and had never found any that did not issue as adults from the parasitized egg of the host. That such a parasitized egg should hatch and that the eggs of the parasite should be retained in the body of the issuing caterpillar—that these should subdivide into a great number of competent embryos—that these in time should develop into larvae, and that eventually from the single egg deposited by the parasite in the egg of the host there should issue a very great number of adult parasites from the caterpillar of the host—all these things seemed absolutely incredible. However, on that memorable day in August, 1902, after a charming luncheon which all four of the children attended, we went into his little laboratory on an upper floor and he showed me his specimens and his methods. I was at once convinced of the accuracy of his observations. His technique had been perfect, his scientific care admirable, and he had proved beyond all question a very extraordinary point in biology.

His subsequent work confirmed this earlier work, and of course it is a matter of common knowledge that it has been confirmed and carried further by Silvestri in Italy, by Patterson in Texas, and by Leiby and Hill working for the Bureau of Entomology.

By the time I returned to the United States, Silvestri's large paper on this general subject had been published, and I wrote a long article for the journal *Science* describing these conclusions and also the

earlier work of Ed. Bugnion of Lausanne who had studied one phase of the development of this *Encyrtus* but who had not observed the egg dissociation and so missed the polyembryonic conclusion. This paper of mine was published early in December, 1902, and at the midwinter meeting of the American Association for the Advancement of Science I chanced to overhear a brief conversation among a group of prominent morphologists in which one of them said, "Have you read Howard's paper in Science?" "Yes," said another, "What a crazy thing!"

It did seem like a crazy thing, but what a wonderful story it all is! Marchal had found the eggs of a little Tineid moth—*Hyponomeuta padella*—on the leaves of a currant bush in his little garden at Fontenay-aux-Roses. He had seen the little black *Encyrtus* puncturing these eggs with its ovipositor, and, with his admirable laboratory technique, he had followed the subsequent history of the two species. I frankly confess that, had the original observation been made by myself, or by Ashmead, or by Pergande, or any one who had frequently reared egg-parasites, the subsequent hatching of the *Hyponomeuta* larva would have meant to us simply that the parasite egg had failed not only to develop but had failed to injure the Lepidopterous embryo. It was a combination of scientific curiosity, of remarkable laboratory technique, of imagination, and, I may suggest, of relative unfamiliarity as to what would naturally be expected under the circumstances, that produced a result which fixed the attention of the biological world on Marchal. I think there can be little doubt that very largely on this work was based his subsequent election to the Académie des Sciences and so of the Institut de France and the various elections to honorary membership in learned societies and other honors that have come to him in number. It's an interesting story, isn't it?

I had the pleasure of visiting Ed. Bugnion at Aix-en-Provence in 1923. It was a delightful visit, and in the course of our talk I referred to his early work with these same creatures, in which he just failed of the discovery which had meant so much to Marchal's glory. He shrugged his shoulders and said that he was not in the least jealous of Marchal, but that it was undoubtedly a combination of circumstances that prevented him from following through. His lectures in the University of Lausanne began at a time when he had to drop his investigations for many months. Before he resumed them Marchal's paper had been published.

Notwithstanding the fact that this extraordinary discovery of polyembryony in a Chalcidoid parasite brought Marchal at once promi-

nently into the view of very many biologists who perhaps would not have heard of him for years, nevertheless he had already carried on certain investigations of prime importance, and he has continued to publish papers, differing in length, always of importance, and all touched with an originality and with an ability to look below mere observed facts and to delve into the reasons for things and their broad bearings. It is this that sets him apart from most other entomologists. His broad biological training has something to do with it; but more than that, it is in the man himself. He makes what is apparently a simple observation; and then he thinks about it, and it becomes a significant thing.

A constant stream of papers has come from his laboratory, largely of his own authorship but sometimes in coauthorship with some one of his associates. Imaginative as he is, there is a conservatism about him which, combined with his broad knowledge, prevents him and his force and his institution from making mistakes, from taking up projects that are bound to fail.

His visit to the United States in 1913 was a delight to all of us; and that it was a pleasure and an inspiration to him is beautifully set forth in his imposing volume entitled "*Les Sciences biologiques Appliquées à l'Agriculture et la Lutte Contre les Ennemis des Plantes aux États-Unis.*"

Traveling with him as I did through New England and then to the Pacific Coast, I was greatly interested to watch his methods. The experience was absolutely novel to him. Everything he saw was new. He was not disturbed; he did not become excited, and he missed nothing. I had arranged the journey in advance, and, as is my custom, had notified people along the route of the time of our arrival. As it turned out, this was not Marchal's way; and as a result before half the journey was over we were two weeks behind our schedule. I expostulated gently, but while the expostulations were courteously received they were unavailing. He insisted on looking into each thing until he understood it thoroughly; and further than that, he took photographs and collected pamphlets and documents and did a lot of other things that seemed really unnecessary. But when his book finally appeared a year later, it became perfectly obvious that everything he had done was with a distinct plan and that after all he had wasted no time. On the whole trip there were no enthusiastic expressions of pleasure. That is not his way. But an occasional remark would show a very keen appreciation. He was looking at things comparatively all the while. As we crossed desert regions he spoke of the similarity of the vicarious vegetation to that of Algeria. When

we were on the shores of the Pacific south of San Francisco, he spoke of the resemblances to the Riviera. The nearest approach to enthusiasm as shown to me was one evening at nightfall when we were climbing up the bench just outside of Pocatello, Idaho. After a long silence, he turned to me and said, "I have often dreamed—" and, as he hesitated, I remarked cheerfully that I had often done the same thing. But Marchal has the power of absolute concentration. I believe that if one fired off a gun beside his ear it would not disturb his trend of thought. So he went on, "I have often dreamed that I was in a strange country where all the birds and all the flowers and all the insects were new, but—I have always awakened! Today I do not awake."

I had opportunity on this journey to show him something of the family life of the Americans, and introduced him a number of times into the homes of friends—sometimes of those who live very modestly, again of those who live on a grand scale. It may be worth while to mention one instance. We were lunching with one of the field workers in a California town, a young man recently married. The luncheon was perfect, beautifully cooked, charmingly served; and the young wife did it all. Marchal was a little slow with his English and thought over his sentences before he expressed them, but presently he complimented the young wife on the delightful meal and the perfect service. "Oh," said her husband, "my wife was a teacher of domestic economy in the University of ———— when I married her." Marchal thought for a moment and then said slowly, "Does madame like the practice of domestic economy as well as she liked the teaching?" The young bride blushing confessed that she preferred the practice.

The World War broke out the summer following Marchal's visit to the United States. He was too old to be a combatant himself, but his only son went to the front at once, and was killed the first time under fire, in the autumn of 1914. I was not able to visit France again until 1920, but corresponded constantly with my friend during and after the war. His letters were of a most intense interest, and he felt the war conditions very keenly but did his full share in the all important sanitary work. After the soul-wracking strife was over, I visited him in 1920; again in 1923, 1925, and 1927. In 1920 we took a long trip together through the South of France, visiting his newly founded stations and seeing many thing of great interest. His assistant, Vayssière, was studying the ravages of the Moroccan locust in a region north of the Gulf of Fos. The farmers of this Department had formed a syndicate, and the Government had loaned them soldiers,

and the soldiers were using their army flame-throwers to destroy the locusts in the early morning and just after sundown (when the insects were sluggish). I was told that the poultry of the region, although hungry for live grasshoppers prior to the coming of the soldiers, later, after tasting the insects when they had been killed by the flame, preferred the roasted locusts and would no longer eat the live ones. Marchal was received everywhere on this trip with the greatest respect. In spite of his extremely modest demeanor, his great worth had evidently become impressed upon all classes of people.

Referring to this apparent shyness, he surprised me in 1923 when we attended the international olive-fly conference together at Madrid. He was made the chairman of the scientific section of the congress, and he presided with a dignity and a *savoir-faire* that commanded my surprised admiration.

When in the autumn of 1928 he was elected President of the International Congress of Entomology to be held in Paris in August, 1932, he declined at once, and finally accepted only at the strong urging of his best friends and those who, therefore, knew him best. After seeing him in the chair at Madrid, I have no doubt of his perfect competence to conduct the presidential functions in 1932.

ITALY

Italy was early the home of many famous naturalists and physicians, and in entomology has produced many well known workers.

Conte Carlo Passerini (1793-1857), Professor in the Museum of Natural History in Florence, was one of the early writers seriously to consider economic entomology. One of his very early papers treated of the olive-fly and was published in 1829. Later he wrote about the insect enemies of a number of cultures. Giovanni Passerini (1816-1893), Professor in the University of Parma, made an especial study of the Aphididae and wrote a number of important papers. Prof. Camillo Rondani (1807-1879), also of Parma, wrote extensively on the Diptera, studied with care the parasitic families, and was one of the earliest writers to advance theories regarding natural control.

Antonio Villa, a learned coleopterist, who began to publish in 1833, became interested in migratory grasshoppers in 1845 and in that year published a significant paper entitled "The Carnivorous Insects Used to Destroy the Species Injurious to Agriculture." This essay was instigated by the offer of a gold medal by the Society for the Encouragement of Arts and Crafts of Milan to the person who should undertake with some success new experiments tending to

promote the artificial development of some species of carnivorous insects which could be used efficaciously to destroy another species of insect recognized as injurious to agriculture. Villa advocated the employment of climbing Carabid beetles for tree-inhabiting injurious forms, of rove beetles to destroy the insects found in flowers, and ground-beetles for cutworms and other earth-inhabiting forms. According to Silvestri, this paper by Villa was praised in certain reviews and criticised in others. It has been entirely lost sight of in later years.

A very ambitious and apparently important work which has been overlooked by entomologists in general is the entomological portion of a great work entitled "The Science and Practice of Agriculture," started under the editorship of Dr. P. Palmeri and Prof. Marcello Pepe in Naples in 1889. A part of this great work entitled "The Injurious Insects of Our Gardens, Fields, Orchards, and Woods; Their Lives and the Methods of Fighting Them" was begun by Prof. Agostino Lunardoni.

The first volume was published in Naples in 1889 and is a large, rather sparsely illustrated volume of 569 pages. The second volume, published in 1894, is Part 2^d of the 11th volume of the main work, under the same authorship. The first volume covered the Coleoptera, and the second the Lepidoptera. Again the illustrations are rather scanty and the volume with index covers 287 pages.

Circumstances that he was unable to control forced Doctor Lunardoni to discontinue the work, and it was taken up by Dr. Gustavo Leonardi, assistant in the Laboratory of Agricultural Entomology in the Superior School of Agriculture at Portici; and the third volume, 539 pages, was published in 1900. It covers the Hymenoptera and Diptera (including the fleas). The fourth volume, also by Doctor Leonardi, was published in 1901, covers 862 pages and completes the work.

As a whole the work is a very admirable one. It covers the whole field in a competent way, and is more extensive than any similar work published in any other country at that time.

There were five earlier Italian writers who should be mentioned. O. G. Costa (1787-1867) wrote on various entomological topics, and among others he published the results of his studies of insects injurious to the olive.

Michael F. Buniva published between 1793 and 1809 six entomological papers of a distinctly economic character. One was entitled (translated) "Dissertation on the Insects that Damage the Wheat Harvest." His largest paper, published in 1809, was a pamphlet of

78 pages entitled (translated) "Memoir on Most of the More Striking Insects that Attack the Plants from which Men Gain Their Nourishment in Piedmont."

P. Ricci, in 1810, published a study of the more injurious insects in the Department of Metauro.

Bernardino Angelini, in the "Bibliotheca Italiana" for 1827, published a paper entitled (translated) "Concerning the Damage Caused Principally by *Noctua gamma* in 1826 in the Veronese Province."

One of the most learned of the Italian entomologists, Achille Costa (1828-1899), published many papers, of which a number were economic. One of them was an especially fine treatise on the insects that attack olive trees and their fruit. This covered 197 pages.

A very good Sicilian economic entomologist, Francisco Minà-Palumbo, began to publish in 1852. He wrote mainly on the insects of the olive and of the vine.

It is worthy of note also that Count P. Bargagli, a well known Italian entomologist, published one paper that may be considered economic, in which he takes up the control of injurious insects by artificially produced disease, following the suggestions made by H. A. Hagen of the United States in 1879. Bargagli's paper was printed in the Italian Journal of Agriculture in 1880.

Writing in 1894, I made the statement that "The work which has been done by the Italian government in the encouragement of economic entomology perhaps surpasses that of any other European nation." In fact, one of the great leaders of the movement which was to establish economic entomology on a firm basis in Europe was Adolfo Targioni-Tozzetti, who lived and did most of his valuable work in Florence. He came from a scientific family, and began to publish as early as 1843. He was a well trained man, and one of his early papers treated of the egg and the embryology of the Cicadas, but his other papers for many years were concerned very largely with botanical matters. After 1866, entomological papers from his hand became more numerous, but with them were also published papers on other animals and upon botany.

He probably came distinctly into entomology, and especially economic entomology, in 1870 when the Phylloxera was threatening the destruction of the Italian vineyards. In 1872 his attention was directed to the Coccidae, and from that time to his death in 1902 he published many papers on this important group. His studies of the scale insects, in fact, were going on contemporaneously with those of the French master, Signoret.

In 1875 a Station of Agricultural Entomology was founded in Florence, and Targioni was made the first Director. From that time on, a stream of publications on different aspects of economic entomology was published by him and his assistants.

He was one of the founders of the Italian Entomological Society, and in 1891 he started the *Revista di Entomologia Agraria* which continues to this day. The Station issued also a large number of pamphlets, and in 1891 published a large and useful volume entitled "Animals and Insects of Growing and Dried Tobacco."

With the assistance of Dr. G. Del Guercio and Dr. A. Berlese, he conducted a very elaborate series of experiments with insecticides, mainly against the Coccidae but also against injurious insects of other groups, and in 1888 published, in collaboration with Berlese, a very large treatise on the general subject of insecticides.

When I came to Washington, in 1878, Targioni was already an economic entomologist of high repute. Professor Comstock's interest in Coccidae, which began in 1879, led to a careful study of Targioni's published work as well as of that of Signoret; and a little later I began an independent correspondence with Targioni. He was looked upon as the foremost exponent of economic entomology in Europe until the time of his death.

About this time, F. Franceschini, Curator of the Italian Society of Natural Sciences, wrote a useful little book entitled "Noxious Insects" ("*Gli Insetti Nocivi*"), published in 1891 as one of the *Manuali Hoepli*. It was well illustrated, and in its 263 pages constituted a good summary of applied entomology as practiced in Italy.

In 1902, I visited Italy for the first time. Targioni had just died. His position at Florence had not yet been filled. I landed at Naples and immediately made the acquaintance of Antonio Berlese and his assistant, F. Silvestri, at the Royal College of Agriculture at Portici, some miles from Naples in the direction of Vesuvius. The visit aroused great enthusiasm in my mind for Berlese and his work. He was a man then in his early forties, who had, as just indicated, been an assistant to Targioni-Tozzetti in Florence, and who had comparatively recently taken the new position of Professor of Entomology in the Agricultural College in the South. He was a man of enormous energy and indefatigable industry. He had been working taxonomically on the Acarina and was spreading out over the whole field of economic entomology. His salary was only 2,000 *lire* a year (less than \$400). The means at the disposal of his department were almost nothing. He made his own drawings and lithographed and printed them with his own hands. Both he and Silvestri worked night and

day. Neither Berlese nor Silvestri spoke English. The latter, however, spoke a little French and acted as interpreter between Berlese and myself. A mutual friendship was begun by that visit, which lasted until Berlese's lamented death in October, 1927.

One of the insects to which Berlese paid rather especial attention and about which he published important papers was the olive-fly; and this suggests a story.

Some months after my return to Washington, the Secretary of Agriculture, James Wilson, sent for me and told me that he had been dining the night before at the White House and had met a charming Italian princess who told him that, knowing the great reputation of the Americans in such practical matters as the destruction of insect pests, she had come to America largely to consult him about the olive-fly and had asked the President to place her at Mr. Wilson's side in order that she might learn from him. Of course the Secretary told her that the olive-fly does not occur in this country and that he knew nothing about insects himself but that he would send an expert entomologist to see her the next day. So he sent me in his carriage, with a card of introduction, to call upon the princess at a house which she and her husband had leased for the season on the corner of Twentieth and Q Streets. The very charming lady told me her story, and said that her husband's olive orchards, which were very large and brought him in a large income, were so badly damaged by the olive-fly that it had become a very serious matter to them. I asked where the groves were situated, and when she replied that they were near Naples, in fact between Naples and Portici, I was able to assure her that the one man in the world who knew most about the subject lived at Portici and that his name was Antonio Berlese. (She was the Principessa Brancaccio.)

Between 1902 and 1905 (the date of my next visit to Italy) Berlese had succeeded Targioni-Tozzetti as the head of the Station for Agricultural Entomology in the museum at Florence, and Filippo Silvestri had been appointed to fill his place in the Agricultural College at Portici. I never knew just why Del Guercio did not succeed Targioni-Tozzetti at Florence, but there was undoubtedly a reason which seemed sufficient to the authorities.

G. Leonardi was the principal assistant of Silvestri. He was a man of small stature and rather delicate appearance, and seemed to be very modest. Silvestri, however, was and is a tall, handsome man of great personal charm and obviously a forceful character.

Silvestri as indicated in a previous paragraph, had been an assistant to Berlese before the latter left Portici, and they were surely

good friends. As a matter of fact, I know nothing personally about their early relations; yet it always seemed strange to me that they should have drifted so far and so violently apart as they did in later years. I visited both of them in 1905, 1906, 1907, and 1908, and although I did not see them together I noticed no differences of opinion.

In 1905 Silvestri was of great assistance to the United States, since I consulted him, among other things, on the subject of introducing the European parasites of the gipsy moth into the United States. As it happened, he had just heard of an outbreak of the gipsy moth in Sardinia, and at once sent Leonardi to the spot, where he collected and shipped to the United States a large number of the puparia of one of the important Tachinid parasites of gipsy moth larvae.

That year, in Florence, I found Berlese assisted by Del Guercio and Ribaga, and just married to his first wife, a very beautiful young Italian girl. He could still speak nothing but Italian. Del Guercio, however, spoke excellent French; and Ribaga, who had studied in Germany, knew German. So they acted indifferently as interpreters between Berlese and myself. Berlese understood enough German and enough French so that he could catch the drift of what the others were saying, and he was very keen on having his ideas properly explained to me. First he would tell Del Guercio to put it into French, and then, dissatisfied with his work, would turn impatiently to Ribaga and ask him to try it in German. While I thought that I understood what he was driving at, I evidently missed some of his points, because he became greatly annoyed at his inability to give me his full meaning.

Berlese about this time or a little earlier had a heated controversy with the bird lovers of Italy in regard to legislation they were trying to secure and enforce regarding the destruction of birds. Berlese insisted that birds were of little account in the checking of injurious insects, but that the important enemies of such insects were parasitic and predatory insects and lizards which abound in south Italy. He appealed to me for my opinion, and quoted my views in one of his longest papers.

Silvestri knew a little French the first time I met him; and before I saw him the second time he had begun to speak English. Since that time he has been a great traveler, has visited most European countries, Africa, the Pacific islands, the Orient, and the United States, thus becoming quite a cosmopolitan and a man who can talk more or less in several languages. Berlese, however, seemed less

adaptable linguistically, but on my last two interviews with him he threw aside his false pride and spoke very acceptable French with me.

The white scale (*Diaspis pentagona*) made its destructive appearance upon mulberries in Italy about 1888, and it was described by Targioni-Tozzetti as "the new Coccid of the mulberry" (*la nuova Cocciniglia del Gelso*). It multiplied and spread slowly, but eventually became so serious an enemy to the mulberry, and therefore to the great silk industry of Italy, that it occupied much of the attention of the Italian economic entomologists. At first, sprays of different kinds were used. On one of my early visits to Florence, Berlese asked me whether the scale occurred in the United States. I replied yes, that it occurred upon peach trees in Georgia and that I had seen it upon peach and cherry trees in the District of Columbia, but that I thought it might be a different species after all, since in one instance, just behind the insectary on the Department of Agriculture grounds, the limbs of an infested peach tree interlocked with the limbs of a mulberry tree and the scale had not gone to the mulberry. I told him, however, that the scale was not apparently a dangerous one with us, and he asked me whether it was parasitized. As a matter of fact, we had not up to that time reared any parasites from it, but I cabled immediately to Mr. Marlatt to secure twigs affected by the *Diaspis* and to forward them to Berlese. This was done. Marlatt found a lilac bush in the garden of a well known lady who lived on H Street, Northwest, and secured her permission to cut some of the twigs for sending to Berlese. Eventually they arrived in Florence, and Berlese reared from them a minute Aphelinine which he sent to me in Washington for naming. I found it to be a new species of *Prospaltella*, and named it after him, *P. berlesei*, sending him the description which was published in the *Rivista* of his Station.

As it happens, this introduction was one of the striking successes in the international exchange of parasites. Under the care of Berlese and his assistants, it multiplied and was colonized in different mulberry groves in north Italy, and, according to reports, was eminently successful in keeping the destructive *Diaspis* in check.

Soon after this came what seemed to me the first break in the friendship between Berlese and Silvestri. Silvestri, possibly incited by the success of the *Prospaltella* introduction, began immediately to correspond with entomologists in different parts of the world and to introduce into southern Italy all of the natural enemies of the *Diaspis* that he could get, not only internal parasites but predators. Berlese objected to this, stating that, having established a good parasite which

was doing effective work, they would be liable to lose the benefits derived from its activities by introducing other parasites, thus bringing about what Fiske subsequently called "superparasitism," and predatory enemies like Coccinellidae which would eat indifferently healthy scales and those parasitized by Prospaltella.

A heated discussion began between the two authorities in the columns of the Italian newspapers and in publications of scientific societies, and the rift in their friendship widened rapidly into a pronounced enmity. The result was that in a short time Italy was divided into two schools, the Silvestri school and the Berlese school. None of the assistants of Silvestri could be induced to say a single good word about Berlese and his followers; and the reverse was equally true. Visiting Florence in 1910, I found Berlese absent, but he sent one of his assistants—Paoli—to my hotel to try to get me to place myself on record as supporting him against Silvestri. This I declined to do, as I did not wish to antagonize so useful and so fine a man as Silvestri. The fight was too strenuous, and I felt that if I had any duty in the matter it was to try to bring the two men together rather than to accentuate the antagonism.

As a matter of fact (although I do not know the exact status of Prospaltella and Diaspis in Italy) my present view is that on the whole Berlese was right. There have been since those days some experiments which seem to justify his attitude rather fully. I have in mind especially the success of *Opius humilis* against the fruit-fly in Hawaii, which was much decreased and hampered by the subsequent introduction of two or three other parasites, by Silvestri himself, who was employed by the Hawaiian government for this purpose.

In 1920, the last time I saw Berlese, I found that he had been given greatly improved facilities in Florence; had a large laboratory, beautifully furnished reception rooms, and had started an especial Prospaltella museum in which, among other exhibits, he had the cover of the box in which Marlatt sent the original lilac branches from Washington. I visited Battista Grassi on this trip, and Grassi made fun of Berlese. (They are both dead now, so that it will do no harm to tell the story.) He showed me a mulberry tree in his garden, badly infested with the scale, and asked, "Where are the Prospaltellas?" And then went on to say (in French), "Berlese seems to think that he is the sole proprietor of Prospaltella and the Prospaltella idea. I do not think that he recognizes the hand of the good Lord in the creation of this parasite."

Berlese, by the way, told me on this visit that he had seen an advertisement in a newspaper to the effect that a South American government offered a reward of 50,000 francs for the discovery of a remedy for *Diaspis pentagona* on the fruit trees in that country. He said that he had visited the consul in Rome and had taken him twigs of mulberry infested by parasitized Diaspis, and that these had been sent out to the South American country. Later he learned from the newspapers that the parasites had taken hold out there and had virtually controlled the scale. He had waited for his reward, and hearing nothing, and being in Rome, he called on the consul who stated that he would consult with his government. Months later, Berlese being again in Rome, again called at the consulate and was informed that a commission had been appointed in his country to make a report on the matter. Again months passed, and again being in Rome he called at the consulate and was told that the committee had decided to divide the price between Berlese, who had sent the parasites, and Howard, who had described the species. Again months elapsed, and eventually Berlese received an illuminated manuscript conveying the thanks of the Government. This illuminated parchment I saw in his Prospaltella museum. But neither he nor I ever heard anything more of the 50,000 francs.

There is one more little story that should be told in connection with this really historical Prospaltella matter: One day, after the success of the Prospaltella had become a matter of rather common information, a charming elderly lady called on me at my office in Washington and introduced herself as the lady who owned the garden in which Marlatt had originally cut the lilac twig. She suggested to me, with a somewhat ironical smile, that it would be only proper for the Italian Government to recognize her agency in this matter; that she would consider the matter if they were to offer her some form of recognition, hinting at a possible Italian title.

Silvestri had already done much sound work when he succeeded Berlese in charge of the entomological work at the Royal Agricultural College in Portici, and this work plainly foreshadowed his subsequent rather remarkable career. He has published upon many subjects, and has shown himself to be a man not only of enormous industry but of brilliant intellect. The stream of important papers that has issued from his laboratory has been of the highest rank, and the number of these publications is astonishing. Of many of the most important, Silvestri has been the sole author, but he has trained a number of fine workers. One can get a good idea of the character of the training given by Silvestri from the large, well illustrated volume

of nearly 600 pages entitled (translated) "Agricultural Entomology According to the Lessons of Prof. F. Silvestri." These lessons, or lectures, were recorded and published under the name of Dr. Guido Grandi, Assistant in the Laboratory of Entomology at Portici. The lessons were originally published in leaflets (*dispense*), and the work as a whole is one of the very best of its kind that has ever been published.

Professor Silvestri has been a great traveler. He has gone on expeditions to Italian Africa for the Italian Government; has visited many parts of the world for the Hawaiian people, principally in order to secure the natural enemies of the Mediterranean and Oriental fruit-flies; for the State of California, to secure parasites of injurious scale insects. He has visited most parts of the world, and has been in the United States on three occasions. He attended the Fourth International Congress of Entomology at Ithaca in August, 1928, and has delivered a course of lectures at the University of Minnesota. He is a man of great force and of much personal charm, and now speaks English fluently. He is one of the foremost of the men who have distinguished themselves as international entomologists.

A number of publications dealing with entomological problems from the economic point of view were published in Italy from time to time during the period preceding the World War.¹

In 1912, L. Vivarelli published two volumes of an Agricultural Entomology, the one on insects injurious to the vine and the other on insects injurious to fruit. In 1924 a revised edition of Volume I, very much enlarged, was published.

This second edition contains nearly a hundred additional pages, reaching the size of xv+350 pages, and carries 93 figures. The

¹ I have just learned some rather definite facts about Professor Silvestri. He was born June 22, 1873, and is therefore at this writing approaching his 57th birthday. He has crowded into his comparatively short life more important work and more travel than any other entomologist whose records are known to me. He has published 113 papers, and he has traveled practically everywhere. He was in the Argentine doing important work as early as 1898. He became Chief of the Department of General and Agricultural Zoology at Portici in 1904, and Director of the Royal Agricultural School at Portici in 1920. He early traveled for the Argentine Government, visiting Formosa as early as 1900. He made wide-spread explorations for the Hawaiian Government in 1912 and 1913. He traveled again widely in the Orient for the State of California in 1924 and 1925. His list of scientific voyages, including parts of South, Central, and North America, Africa, China, and Japan, have numbered 21. He is an honorary or corresponding member of 23 learned societies, and has been the recipient of four great prizes. The last one was the Grand St. Hilaire Medal of the National Acclimatization Society of France.

author in his preface states that it is slightly modified from the first edition and contains quite a number of additions, especially with regard to control measures, *i. e.*, those which by recent experimental trial and practical application are recognized to be the most effective and at the same time the easiest and most economical. The author at the time of writing was an assistant in the "Cattedra" of Natural History and Phytopathology in Conegliano. The work is largely compiled, but is said to be based upon actual field experience.

One of the most notable of these before-the-war publications was a pamphlet by P. de Stefani published in Palermo in 1914 and entitled (translated) "Insects Occasionally Injurious to the Vine." Professor de Stefani has written a number of sound articles on various injurious insects, especially those of Sicily.

There have been three rather prolific writers of short articles during the past few years in Italy. One of these has been Prof. G. Paoli, a former assistant to A. Berlese. He has been stationed near Genoa, and has done some very good work. E. Malenotti has published about a large number of injurious insects, both under the Ministry of Agriculture, in the journal *Redia*, and in agricultural newspapers. G. Martelli has also been a writer of frequent short articles on different aspects of agricultural entomology during the past few years.

These men and some others are connected with the service known as *Cattedre Ambulanti di Agricoltura*. These traveling chairs of agriculture are placed in the chief towns of the provinces, and are supported by contributions from the State, the province and local institutions. Their object is to assist local agriculture, and their men act as what we would term in this country, possibly, glorified county agents. As a rule, they are better trained than the so-called county agents in this country. They have charge of the fight against insect pests and plant diseases under the control of the Central Phytopathological Observatory, and they form a bond of union between the Ministry of Agriculture and the farmers. This service has been found to be very important, and the system has been strongly supported by the present Fascist Government.

Italy has therefore been one of the most active countries in work in economic entomology. This is shown in a rather striking way in a large work by Dr. Gustavo Leonardi, published long after his lamented death, which is a consideration of the species of injurious insects and their parasites recorded in Italy to the end of the year 1911. It was published in three large parts by Professor Silvestri at Portici. While it is little more than a list it is very impressive. The bibliography alone covers 142 pages, and a study of this bibliography

shows that down to the end of the year 1911 no less than 584 Italian writers had published on some aspect of the injurious insect question. And then too, many unsigned articles are listed, as well as articles published in Italy under the authorship of a few men of other nationalities. My own name, for example, occurs twice in the list.

We have previously referred to Doctor Leonardi in connection with the completion of Prof. A. Lunardoni's great work, and he was really a learned, useful and important man.

Antonio Berlese died in 1927, after a life of most arduous and important work. He was one of the greatest of the European economic entomologists. Dr. G. del Guercio, early associated with him in Florence when they assisted Targioni-Tozzetti, and afterwards Berlese's principal assistant when he returned to take Targioni's place, is now acting in charge. Doctor del Guercio has, therefore, had a very long experience. He has been a prolific writer, and an investigator of very high rank.

GERMANY

It seems safe to say that for very many years the German-speaking countries considered it worth while to pay especial attention to only one branch of applied entomology, and this came from the needs of forestry. Forest culture in Europe, of course, is very old, very important, and much advanced in comparison with America for example. Here it is a recent development, and forest entomology has only in comparatively recent years been considered as an important study. German entomologists early assumed the leadership in this direction, and made careful studies of forest insects as early as the close of the eighteenth century.

The best and most comprehensive work on the subject, however, was prepared by J. T. C. Ratzeburg, who was born in Berlin in 1801. His father was a professor of botany, and he studied botany in his early days. Afterwards he studied medicine and was admitted to practice. When, however, the Forest Academy was started at Eberswalde (near Berlin) in 1831, he became attached to the staff and devoted himself for the rest of his life to forest entomology. He died in 1871. He had already done some entomological work before his connection with the new Forest Academy, and in 1837 published the first edition of Volume 1 of his great work on forest insects, which included a consideration of Coleoptera. The second edition of this volume appeared in 1839; and Volumes 2 and 3 followed in 1840 and 1844 respectively. Each of these volumes was accompanied by a large number of carefully prepared and beautifully executed plates,

some of them in colors. The work as a whole was a magnificent contribution to science and to forestry. In 1844 to 1852 there were published, as additions to this great work, three volumes entitled "Die Ichneumoniden der Forstinsecten," an elaborate and very careful work which has been very useful and scientifically very important. Both works were basic and have become classic.

The principal works which followed Ratzeburg's were Eichhoff's "European Bark-Beetles" in 1881, Bernard Altum's "Forest Zoology" published in Berlin in 1881, and a great two-volume work by J. F. Judeich and H. Nitsche entitled "Manual of Central European Forest Zoology." This last work remained a standard for many years. In 1914, K. Escherich published in Berlin a revision of the last-named work. This was a true revision, including much new matter and using additional illustrations. Just before this, Otto Nüßlin published, also in Berlin, a volume on forest entomology which seems to have been very well done.

Doctor Judeich was the Director of the Forest Academy at Tharandt near Dresden, and Doctor Nitsche was Professor of Zoology in the same institution. Doctor Altum was Professor of Forest Zoology at Eberswalde, and was therefore a successor of Ratzeburg. Through his care and that of Doctor Eckstein, his successor, the original Ratzeburg collection still remains at Eberswalde in excellent condition, where it may be studied by specialists in forest entomology. Eichhoff was Royal Head Forester at Mulhausen, Alsace; and Doctor Escherich was a successor of Doctor Nitsche at Tharandt, but is now the Director of the Institute for Applied Entomology at Munich.

Germany has had very many great entomologists. Their writings have been consulted by the entomologists of all other countries. Germany's standing in most branches of scientific endeavor was fully sustained by her entomologists, but, aside from this one branch of forest entomology, economic entomology received little attention until comparatively recently. The necessity for work of this kind in central Europe was not obvious. In the summer of 1893 or 1894, the chief of the Agricultural Section of the Ministry of Agriculture of Prussia, in conversation with the writer, argued that Germany did not need to employ general economic entomologists and that its experiment stations seldom received applications for advice on entomological topics. When an especial insect like the *Phylloxera* sprang into prominence, the work could be handled by special commissions.

There were, however, very many papers and several books published in the German-speaking countries prior even to 1862 (the date of the publication of Hagen's "Bibliotheca Entomologica"). Among

the books, there was, for example, a volume by P. F. Bouché on the "Natural History of Useful and Injurious Garden Insects," which was published at Berlin in 1833. This was a volume of 216 pages with a number of steel-engraved plates. It was a good book, but was not comprehensive enough for farmers, and it also included forest insects although these are not mentioned in the title.

In the same year (1833) another book was published that deserves mention. It is entitled (translated) "The Lives and Development of Some Insects Injurious to Agriculture," by Ferd. Jos. Schmidt.

In 1836, J. C. Zenker's "Natural History of Injurious Animals" was published at Leipsic. It was a well planned work, but practically incomprehensible to the non-entomologist.

In 1844 appeared a comprehensive work by C. A. Loew bearing the title "Natural History of All Insects Injurious to Agriculture." This was a painstaking compilation, but, as Nördlinger says in the introduction to his book published 11 years later, it could "not be recommended to farmers, inasmuch as the entire subject has been treated by the author without criticism of the many remedies cited for insect control. For this reason, he who would care to take the author's advice will waste much energy and money."

A later book deserves rather careful consideration. It is (translated) "The Small Enemies of Agriculture," etc., and is a volume of 636 octavo pages, published in Stuttgart in 1855. Its author was Hermann Nördlinger, born in 1818. This volume seems to be rare nowadays, and, although I have been trying for a number of years to find a copy to purchase, I know of but one example in this country and that is in the Hagen Library of the Museum of Comparative Zoology in Cambridge, Massachusetts. It is a very well printed book, not apparently well known to American or English students, through the fact that it has never been translated into English as was Kollar's earlier book. It has a very distinct historical value through its analysis of the earlier literature, and is an easy book to use since it has a good list of the literature consulted, an admirable table of contents, very full indices, and tables classifying and referring to the species in accordance with the classes of damage. The method of treatment is on the lines of zoological classification, some preliminary pages being given to mollusks, true worms, Acarids, and Myriapods. The treatment of the insects occupies the bulk of the book (from page 31 to page 597, inclusive). A long list of insects is considered, and very many species are illustrated by fairly good woodcuts.

Apparently it is a full and competent consideration of practically all the injurious insects of Central Europe, with very up-to-date

information for that time. Full life histories are given for most of the important species.

An extremely useful German work, entitled (translated) "The Plant Enemies of the Class Insecta," is a large, 848-page book bearing the date 1872, the author of which was J. H. Kaltenbach. The author was born in 1807 and died in 1876. He was a teacher at Aachen, who had made a reputation for himself by his monographic work on plant-lice.

The work under present consideration was published originally under another title as a series of papers in the Proceedings of the Natural History Society of Rhineland Prussia, beginning with the year 1856. These were finally brought together in admirable book form and published by Julius Hoffmann of Stuttgart. Although the title page bears the date 1872, the introduction is dated 1873. I did not buy this book until 1888, but since then it has been constantly on my desk and consulted very frequently. It contains no illustrations of insects, but the whole work is grouped under the classification of the plants, under the name of each plant being given the names of its insect enemies, long paragraphs being devoted to the most important of these. The plants themselves are illustrated by good line woodcuts, and there are full indices of the Latin and German plant names and of the Latin insect names, the latter being arranged according to their classification, the genera under each large group being arranged alphabetically.

The usefulness of such a book to the economic entomologist is at once evident, since, although no remedies are given, he can see at once any important European insect with the plant upon which it feeds, can gain a sound idea of its life history, and through its use we in America have been able to gain easy first-hand information as to the injurious insects we are likely to meet with in plant importations of any kind.

In 1879 and 1880 there appeared a work in Germany which, taking everything into consideration, was the best thing that had been published concerning applied entomology down to that time. It was not really a book on applied entomology in the modern sense, but perhaps in the care and thoroughness of the basic treatment of the insects it was a model for present-day writers.

The author, Dr. E. L. Taschenberg, was born in 1818 and died at the beginning of 1898. He was at first a botanist, and his early papers were upon botanical subjects. In 1856, however, he was appointed Director of the Zoological Museum in Halle, and began to write about insects. He soon became a very well informed entomologist. Appar-

ently he did little original research, and his works for the most part were compilations, but they were very useful compilations. In 1871 he published a book entitled "Entomology for Gardeners and Garden Friends," in 1874 one on "Forest Entomology," and in 1879-80 his big work, the title of which we may translate as "Practical Entomology." It appeared in five volumes, well printed and well illustrated with 326 well drawn and well engraved woodcuts. The whole work included 1410 pages. I believe that there was no English translation of this valuable work. It is a pity, since such a translation would have been very useful to the people in the British Isles, and, since many of the insects considered have been carried by commerce to many other parts of the world (as we shall show in our section on Kollar's work), it would have helped very many people. As it was very largely a compilation and not the result of original research, it does not seem to have been considered especially by the German scientific men, but nevertheless it was good and sound and full.

Contrary to a frequent method of considering injurious insects by crop classification, the matter is arranged according to the classification of the insects, just as is done in Dr. H. T. Fernald's book on "Applied Entomology." Looking through the pages, one finds everywhere data brought together in such a way that, had it been written in English, it would be frequently quoted today in publications written in that language. It considers not only German insects, but those species which the author thought would be found in Germany in the then near future.

From the view-point of remedies, it is no stronger than any one of the European books of that period or earlier, but a distinct effort was made wherever it was possible to show, in the concluding paragraph of the consideration of each species, after a side-heading "Gegenmittel," such measures as might be adopted. There is little doubt that had this great work been linguistically available to the American workers of the eighties it would have been a very great help to them, and in fact would be so today.

On the death of Doctor Taschenberg, the great English journal *Nature* had this to say about this work:

In the absence of any satisfactory general textbook on the subject published in this country, this work is indispensable to any serious study of injurious insects in Great Britain as well as in Germany.

Doctor Taschenberg published but one more paper in the 18 years following the publication of this *magnum opus*. This was one on Hymenoptera, which appeared in 1891.

In 1890 there was published (apparently simultaneously in Berlin and Vienna) a very good little book entitled (translated) "Insects Injurious in Agricultural Fields and Kitchen Gardens, Their Life Histories and Remedies." The author's name as published was Gustav Henschel. The book covers about 230 pages, and its titles are arranged alphabetically. It seems to be somewhat of the nature of Kaltenbach's "Pflanzenfeinde." Remedial suggestions, however, are not very abundant or very complicated; but it is a good, practical, little work.

In 1895, in Berlin, there appeared a book entitled (translated) "The Injurious Forest and Orchard Insects, Their Life Histories and Remedies, a Practical Handbook for Foresters and Gardeners." The author's name given is G. A. O. Henschel, but he was the same man whose name is given in the preceding paragraph. The publication of this book was a rather notable incident in entomological progress. It contains more than 750 pages, is well illustrated and accompanied by synoptic tables. It contains a great mass of useful information. I have given the date as 1895, but I note on the title page that this is the third, corrected edition.

An interesting little German work was published at Frankfort in 1899, on "Garden Insects." It is by Heinrich Schilling, and is a very good little handbook for persons interested in gardens.

In an important address on "The Development of Applied Entomology in Germany," delivered before the Third International Congress of Entomology at Zurich in July, 1925, Dr. K. Escherich dealt with the international character of the study and spoke with enthusiasm of the stimulus given to forest entomology by Ratzeburg and also of Taschenberg's work and that of Reh. He showed that, aside from forest entomology, the other branches of applied entomology were for many years largely neglected, and this statement applied particularly to agricultural entomology. It is true that there were a number of agricultural experiment stations and similar institutions, but the object of these stations was mainly to investigate plant biology and pathology and questions of plant breeding and seed control. When damage caused by insects became alarming botanists were consulted, and entomological problems were confided to botanists employed in such research institutions. He spoke well of the work of these men, but said that it was all preliminary, since work of this kind requires a broad zoological training and a knowledge of insects.

I well remember on my first visit to Hamburg in 1902 that I found Dr. Ludwig Reh working under the recently passed decree prohibiting the entrance of American fruit on account of the danger from the

San Jose scale. I had a long talk with Doctor Reh at that time and found that he was chafing under existing conditions, since the director of the work was a botanist and he could see no reason why an entomologist working upon an entomological problem should be controlled by a botanist who had no just idea of entomology. Doctor Reh did not confine his opinions to this private conversation, but made them generally known in Germany, and there began to arise a general feeling that Germany was in a way neglecting an important subject. This feeling grew, and Doctor Escherich, on his return from his American journey in 1910, published a book on his observations. In his Zurich address he said (translated),

The effect of this booklet surprised me more than anything. Enthusiastic comments came in from all sides. I realized that the time was right for the development of applied entomology which for a long time had been earnestly pushed by Doctor Reh and others but in vain. The ice was broken, and the development proceeded in an accelerated tempo. The call for the formation of a "German Society for Applied Entomology" was well answered, and in the fall of 1913 the first meeting was held in Würzburg and was attended by a large number of scientific men, practical farmers, and representatives of the different State governments.

At this time a journal was started, entitled *Zeitschrift für angewandte Entomologie*, and found abundant material for publication.

It thus seems that there was, during the first ten years of the present century, a growing feeling among certain entomologists and perhaps others in Germany that not enough attention in that country was being turned towards applied entomology. Very likely the work that was being done in this country, in some of the English colonies, in Italy, Russia, and France, helped to a considerable extent in promoting this feeling. Economic entomology apparently was not taught in the educational institutions, and there were no official entomologists. As we have seen, the books that had been published were written by men who had no official standing with the general government.

The situation, therefore, needed only the incentive of the publication of Escherich's extremely enthusiastic book, "*Die angewandte Entomologie in den Vereinigten Staaten*," and his forceful personality to bring about the very general appreciation of the value of such work and to start the movement indicated in his Zurich address.

In this address Escherich spoke of the sympathy with which this book was received and the congratulatory letters that he received. But there were nevertheless somewhat critical comments. Dr. Walther Horn, for example, while praising the book, came to the defense of German entomology, showing that Escherich had really

criticised German entomology by comparison when he should have specifically criticised only German *applied* entomology. Undoubtedly this criticism was justified, even though Escherich's fault consisted only in the accidental omission of a single word. In later publications Doctor Horn has defended German entomology, but as a matter of fact it needs no defense. There have been great writers in Germany, and great workers, and the world is indebted to them for their enlightened labors in matters of taxonomy and biology and in many other directions, and, as we have just shown, a number of important works on economic entomology have been published in that country.

Another somewhat critical statement was published by M. V. Emelianov, a well known Russian entomologist, who visited the United States a year after Escherich's journey. He referred particularly to Escherich's apparent failure to realize the importance of the work of the State Experiment Stations. His words are (translated):

Escherich allotted only one page of his book to the work of the State Experiment Stations, which does not at all correspond to their actual significance. In the first place, there are about 60 such stations, and in many of them the quality of the work done is not in the least lower than in the Washington Bureau. In general, their work and merits are no less than those of the central organization.

Emelianov is perfectly right in this, and Escherich would be the first to acknowledge it. The present writer readily assumes the blame in this matter. Escherich's stay in the United States was short. He came at the writer's invitation (although at the expense of Andrew Carnegie) and the writer accompanied him personally across the country to California and back again. The time (three months) was too short to gain more than a good working knowledge of the operations of the Federal Bureau. Escherich was told of the work of the stations, but visited only two of importance—those at Cornell University and at the University of Illinois. I am sorry now that we did not visit more of them.

Nevertheless, Escherich's book was sound and most suggestive. It was frank and honest. He was keenly appreciative of all that I showed him, but he also criticised certain American acts and conditions. He was a perfect traveling companion, a man of the highest intelligence and of the broadest interests, and at the same time of the most perfect sympathy—a rare combination. It was his influence and that of Reh that started effectively the remarkable interest in applied entomology that Germany shows today.

Almost simultaneously with the founding of the German Society of Economic Entomologists in 1913, appeared an excellent large volume on the animal enemies of plants by Dr. Ludwig Reh. This

was the third volume of the third edition of Dr. Paul Sorauer's "Handbook of Plant Diseases." The first edition of Doctor Sorauer's work was published in one volume in 1874 and was concerned only with plant diseases, although one of the gall-mites is mentioned. The second edition, published in 1886, contained two volumes, and at the close of the second volume some consideration was given to plant galls, some of them, of course, caused by insects. The third edition comprised three volumes, the first two devoted to diseases, and the third (published in 1913) was on economic zoology. It is a very good and very comprehensive work. Doctor Reh, in a most readable introduction, explains the difficulties of his task and has some very significant things to say on the subject of nomenclature. He states that since the time of Taschenberg zoological phytopathology had been almost entirely in the hands of the botanists and that therefore it is not to be wondered at that the same name had been given by them to insects of different families and even of different orders. This produced what he calls such a *Tohuwabohu*¹ that even the specialist had great difficulty in finding out what was what.

The volume, which covers 774 pages, royal octavo, is admirably done and well illustrated with more than 300 text figures. Doctor Reh's command of the literature is surprising, and references are given to original sources in extensive footnotes on almost every page. He seems to have known the publications of other nations quite as well as his own. A good chapter on the subject of remedies, by Dr. Martin Schwartz, covers the last 22 pages of text. Doctor Schwartz seems to have been equally well informed regarding the work in America and elsewhere.

The report of the Chief Plant Protection Station in Baden for this same year (1913) contained a great deal of matter concerning injurious insects—sufficient, in fact, to warrant a very good two-page review in the Review of Applied Entomology. The report is by C. v. Wahl and K. Müller. This report is so full and so careful that it is quite possible that its publication in this form was influenced in some degree by the movement started by Doctor Escherich.

The next year came the World War, and, as Escherich pointed out in his Zurich address, every one soon became convinced of the necessity of an intensive and scientific campaign against insect pests. Bodylice were brought in by the Russian prisoners; numerous insect pests infested stored food products to an alarming degree; the crops were damaged sometimes to the extent of 50 per cent, and all this just at a time when every grain of corn and every apple was of great value.

¹ I rather like this Hebrew word, although it really means chaos.

Doctor Hase was sent to the eastern front to study the lice; others were sent to the Southeast to study the malarial mosquito, and a campaign was organized for the control of grasshoppers in Asia Minor.

At the close of the war the effect of this renewed interest was evident. The Biologische Reichsinstitut was reorganized under Dr. O. Appel, and entomology was well represented. At the time of Escherich's Zurich address there were 20 entomologists connected with that institution, some of whom were at work in field stations.

In 1925, agricultural entomology, which hardly existed 20 years earlier, had reached a standing in Germany practically the same as forest entomology, although there were fewer teachers in the agricultural high schools. The laws of Germany were modified so that arsenical compounds were permitted as insecticides, and the dusting of forest areas with airplanes began. Moreover, the fumigation of mills, storehouses, ships, and dwelling houses with poisonous gases was permitted by law. So the chemical industry profited by a new insecticidal development.

About the same time that Doctor Escherich gave this address, volume 4 of the fourth edition of Sorauer's "Handbook of Plant Diseases" appeared (1925); and there is to appear a fifth volume to complete the fourth edition. The fourth volume is devoted almost entirely to insects, as will also be the fifth volume. Doctor Reh was again the editor, but no less than five younger economic entomologists were his collaborators, namely Dr. H. Blunck, Dr. K. Friederichs, Dr. F. Stellwag, Dr. S. Wilke, and Dr. F. Zacher.

In his introduction Doctor Reh refers to the fact that during the war German workers had no access to the publications of foreign countries, and that it would have been very difficult for him to bring his revision up to date had it not been for the invaluable Review of Applied Entomology published by the Imperial Bureau of Entomology of Great Britain. A set of this publication, including all the numbers published during the war, enabled him to see what had been done; and the result is that this 1925 volume seems entirely competent. It contains many new figures and much sound information.

A short paper entitled "Reminiscences" had been published by Ludwig Reh (*Anzeiger für Schädlingkunde*, vol. 3, 1927, no. 4, pp. 37-41). This very frank and outspoken paper throws much light on the position held by entomologists and economic entomology in the eyes of even the scientific public in Germany at the end of the last century. Although naturally interested in insects, Reh was so influenced by the opinions of scientific men that he avoided their study until in 1895 he went to Brazil where he was struck by the enormous

numbers of insects and by their economic importance to man. Then he went to Switzerland, where he associated with certain famous entomologists and where he saw in the Concilium Bibliographicum at Zurich some of the bulletins of the Division of Entomology of the United States Department of Agriculture. This experience opened up the field of applied entomology to him. He had never heard of it before, and in 1897 he published his first paper, entitled (translated) "Troublesome Guests of the Insect World." He was appointed in the spring of 1898 as Zoologist at the newly established Station for Plant Protection in Hamburg, and his duty was to examine plants and plant products coming from the United States, to prevent the introduction of the San Jose scale. He had many difficulties there. The organization was dominated by a botanist, Doctor Brick, and he was not allowed to sign his own manuscripts. During the early part of the present century Reh constantly labored to secure a recognition of applied entomology in Germany, and from his work it is probable that many minds were prepared for the movement started by Eschrich on his return from the United States in 1910 which resulted in the founding of the German Society for Applied Entomology and the many important publications and activities that have come about.

There is no doubt of the very high quality of the work in economic entomology which is now being done in Germany, nor of the fact that they are rapidly publishing valuable results. Important new books are constantly appearing, and will continue to do so. An excellent one was published in 1927, on the subject of the insect enemies of stored products. It is by Dr. Friederich Zacher, of Berlin. It covers 365 pages, with 123 text figures and 8 very good colored plates. It is the largest and latest general work on this subject, and seems to be thoroughly up to date. Doctor Zacher began his work in this direction in 1917, and has evidently studied it most carefully and intelligently. The book contains many new pictures illustrating damage.

Prior to the World War the Germans were doing some good entomological work in German East Africa and in other German colonies that no longer exist. The work by H. Morstatt was especially notable; while F. Zacher, writing in Berlin, published accounts of colonial pests. The work by K. Friederichs on the coconut beetle in German Samoa should be mentioned in this connection; and F. Zacher published a general review of African cotton insects.

Fortunately, just as this work is closing there has appeared a very fine two-volume work by Dr. Karl Friederichs entitled "Die Grundlagen und Gesetzmässigkeiten der land- und forstwirtschaftlichen Zoologie insbesondere der Entomologie." The two volumes cover

nearly 900 pages, and are fully illustrated. Doctor Friederichs has shown himself a keen student and an admirable reasoner. While the work includes all of economic zoology, the greater part is devoted to entomology. It discusses the broadest questions in the broadest way, and is a mine of information. In Volume 2 the author goes into historical matters to some extent, and I have learned from the book more than I realized of the situation in Germany. Under the Biologische Reichsanstalt at Dahlem, a Berlin suburb, the Service for Plant Protection includes everything indicated by the name, and injurious insects are cared for. Doctor Friederichs shows that a zoologist is chief of the economic division and that he is also in charge of the laboratory of general plant protection. Under him are 32 scientific men, of whom 15 are zoologists. Entomologists are trained at the University at Rostock, and the only professorship of phytopathology is at Bonn. The Plant Protection Institute at Berlin-Dahlem maintains 15 laboratories for applied biology, and these constitute the economic division. Of these 15 laboratories, one is for forest zoology, one for the investigation and control of the nun moth, one for the investigation of stored product insects, and one for bee investigations. There is a distinct division of the Institute dealing with insect problems all over Germany, and this division maintains a laboratory for Phylloxera control, one for grape insects, and one for fruit insect investigations. Of the branches of different sorts, there is one in Stade for the investigation of orchard insects, another in Rosenthal near Breslau for the control of the sugar beet maggot, and one in Rastatt for the investigation of corn borer. There are over the country 28 offices giving advice and information as to agricultural problems and also reporting to the central office on the occurrence of outbreaks of insects.

I cannot praise Dr. Friederichs' volumes too highly: they are admirable. He has introduced paragraphs on von Frisch, J. G. Schäffer, G. L. Hartig and a few others which I might well have used in this brief sketch of economic entomology in Germany.

AUSTRIA

Just as in Germany, Austria has paid more attention to insects affecting forests than to those affecting agricultural crops. However, one of the best general books (possibly the best) published in Europe during the first half of the nineteenth century was written by Vincent Kollar, born in Prussian Silesia, who, at the age of 20, joined the Museum of Natural History in Vienna, where he spent the rest of his active life. He was born in 1797 and died in 1860. In the Museum

he rose from the lowest position to the highest. He was a good all-around entomologist, and published many papers upon different aspects of entomological science. He seems to have been especially interested in life-history work, and in fact one of his earliest papers was on the life history of the common domestic mosquito. In the 1830's the Royal Agricultural Society of Vienna recommended to the Government the preparation and publication of a popular natural history of insects injurious to vegetation. The Emperor authorized the undertaking and commanded its speedy execution. The work fell largely to Kollar and to Joseph Schmidberger, and the volume was published under Kollar's name in 1837.

Fortunately, for English-speaking entomologists, farmers, and fruit-growers, the work was soon translated into English by Jane and Mary Loudon and was published in London in 1840. The manuscript was carefully read by Prof. J. O. Westwood, who inserted footnotes, sometimes very long, throughout the book, often giving additional information on habits and remedies and referring to articles published in English in the *Gardeners Magazine*, *Gardeners Chronicle* and elsewhere. The work was carefully written, well printed, covered about 400 pages, carried some good illustrations which I believe were made especially for the English edition, probably by Curtis since what are evidently prints from the same blocks occur in many instances in Curtis' published writings. Rather more than 120 species of injurious insects are treated, often very fully, with full accounts of the life histories of many of them. Schmidberger seems to have written nearly all of the matter in the book relating to insects injurious to fruit culture, for which he was evidently well fitted since he had been writing on these subjects in short articles for a number of years. His portion of the book is very full and apparently authoritative.

All through the book one looks in vain for economical and practical suggestions as to control. Hand collecting at certain times is recommended for many species.

It is interesting to study the list of what may be assumed to have been the most important injurious insects of Austria in the early 1830's. As above stated, in the neighborhood of 120 species are considered in this book. In glancing over the list I recognized at once 35 species that have been introduced accidentally into the United States and have become well known pests. I then submitted the list to a number of specialists in the different orders of insects, who pointed out to me 14 additional species that also occur in the United States and that undoubtedly have been introduced either from Europe or

from some other part of the world from which they also came to Europe but, presumably at an earlier date. As is quite to be expected, household insects, greenhouse insects, and species affecting domestic animals seem to have become at least partially cosmopolitan at an early date. Of the rest, those insects that attack fruit trees and vegetables are the most numerous among those that have found their way to the United States; and of these, the Lepidoptera seem to have been more numerous than the beetles. Of the forest insects, there seem to be very few that have established themselves over here. These are notably the gipsy moth, the brown-tail moth, the pine-tip moth, the satin moth and the leopard moth. This is a rather interesting and forcible indication of what happened to this country before our plant-quarantine law passed Congress in 1912.

Of course it is quite possible that there are additional species mentioned by Kollar that may exist in this country and that for some reason or other have not been noticed. For example, the apple weevil of Europe is included in the great Leng catalogue of the Coleoptera of North America and is doubtfully recorded from Ohio. Again, the fruit insect called by Kollar "the oblong weevil" has been found in New York State but there is no indication that the species has as yet become established there.

Kollar, being a museum man, seems to have had little practical experience with economic insects beyond working out possibly the life histories of some of them. The fullest individual accounts of insects in the book are written by Canon Schmidberger.

None of the modern methods are recommended. No sprays were used in those days. Again and again the statement is made that there is no remedy except hand-collecting, but, as life histories are well worked out, the times when such hand-collecting can be done to best advantage are pointed out.

Trapping moths to light is mentioned but is not recommended, and it is pointed out that it is males that are most attracted and that, in some cases at least, the gravid females are too heavily laden with eggs to fly readily to light.

For underground insects, frequent breaking up of soil to expose such insects to the birds.

An infusion of wormwood, also used with road-dust, is recommended for the *Haltica*s.

Traps, such as manure-filled holes for mole-crickets and ditches for young grasshoppers, are mentioned.

Boiling water as an application for certain insects is also mentioned. As deterrents, sulphurated oil and oil of turpentine.

Lime on the soil.

Lye.

Tobacco smoke for aphids.

Mention is made of trap crops, by the recommendation of an occasional parsnip plant in a carrot bed for the carrot moth, the statement being made that the parsnip plant will be preferred by the moth for oviposition.

Powdered charcoal is recommended for the onion maggot.

Loosely rolled-up pieces of old cloth or blotting paper in the forks of the trees will attract caterpillars for shelter, and, thus collected, they are easily destroyed.

Collecting certain beetles by jarring the trees, when they will fall on spread sheets.

Hand-destruction of the wintering nests of the brown-tail moth and the egg-masses of the gipsy moth.

Hand-collecting of the eggs of the satin moth.

With bark-beetles, such as *Tomicus*, the felling and barking of infested trees is recommended; also felling the first-bored stems without delay and burning them into charcoal, or conveying them out of the forest as soon as possible, or at least taking off the bark which should be carefully burned.

Austria has never had, so far as I know, a distinct organization for the study of economic entomology other than forest entomology, but, in addition to the Kollar book, a number of interesting papers have been published. Georg Ritter von Frauenfeld, writing from 1847 to 1861 and again from 1864 to 1869, published several papers of an economic bearing. Most of them were short and were published in the Proceedings of the Vienna Botanical-Zoological Society.

Another Viennese writer was Gustav Adolf Kunstler. His economic papers were dated 1864 and 1871 and were published in the same Proceedings as von Frauenfeld's.

Especial mention should be made of the very wonderful plates of insects injurious and beneficial in the forest, field, and garden, done by H. M. Schmidt-Goebel, published in Vienna in 1896. These plates (colored and wonderfully well done) illustrated not only the different stages of many injurious insects but also of their natural enemies. I have seen 14 of these plates, each containing 30 or more figures. The plates measure 39 x 46 cm.

Just as in Germany, forest entomology has always been well cared for in Austria. At the Royal Institute for Forest Investigations at Mariabrunn (near Vienna) research was carried on for very many years on the biology of forest insects, and to this Institute were referred questions relating to economic entomology in general. An

excellent worker at this Institute was Dr. Fritz A. Wachtl. The proceedings of an important congress of silviculture in Vienna in 1892 were largely taken up with discussions and reports concerning the nun moth and its very great devastations in the coniferous forests of Austria.

After the World War a federal Institute for Plant Protection was established in Vienna and has been rather active. B. Wahl has published annual reports on the work of the Institute in regard to insects; and other writers on this subject in Vienna have been F. Zweigelt, K. Meistinger, and L. Fulmek. M. Seitner has also published on forest insects.

In Dr. Karl Friederichs' just published book the following facts are mentioned regarding Austria. There is a professorship of Forest Protection, dealing especially with forest zoology at the High School for Soil Cultivation in Vienna. Scientific institutions relating to agriculture and plant protection are the Bundesanstalt for Plant Protection at Vienna, the Forest Bundesversuchsanstalt at Mariabrunn near Vienna, and the Versuchsanstalt for Vine, Fruit, and Gardens in Klosterneuburg near Vienna. There is also a corporation, "Austrian Plant Protecting Association," which stands half way between a departmental and commercial institution, which also gives advice and information as to agricultural problems, but appears to be partial to certain products in which it is commercially interested.

HUNGARY

Following the extraordinary spread of the grapevine *Phylloxera* in Europe in the latter half of the last century, there was founded in 1881 at Budapest a *Phylloxera* Experiment Station which was organized by Dr. Geza Horvath of the Hungarian National Museum, already well known for his admirable work in the fields of economic and taxonomic entomology.

As the *Phylloxera* question, however, became more and more elucidated, and as the means of defense against this scourge became reduced to a practical basis, the work of the station became directed more and more toward other noxious insects. As the change in its functions became quite definite, its title also changed, by vote of the Legislative Chamber and the sanction of the King, to The State Entomological Station. It was placed under the Ministry of Agriculture, and offices were established in the palace of the Minister of Agriculture at Pesth. In 1894 the personnel of the station was composed of the Director, two assistants and a messenger, and was supported by an annual appropriation of 8,000 florins. A special

corps of reporters was organized, who sent in regular reports on the occurrence of destructive insects in their respective regions. The reporters were farmers and forestry agents, and they served gratuitously. In case of serious damage one of the employees of the station was sent into the field for study and experiment. A general report was published every year in the comprehensive Annual Report of the Ministry of Agriculture addressed to the Chamber of Deputies. Special reports were also published, which were gratuitously distributed to the public. Horvath remained in charge of the station until 1896, when he went back to the National Museum where he served as Director of the Zoological Department until his retirement; continuing, however, entomological work of great value but relating chiefly to the insects of the order Hemiptera. He is still living and active though long past his 80th year; and in 1927 was the President of the Tenth International Zoological Congress. This indicates his high rank among zoologists in general, including of course the workers in entomology.

In 1890 Josef Jablonowski was taken on by Horvath as a temporary assistant in the Entomological Station, where Karl Sajo had already been working with Horvath for two years. During the next two years they investigated the Moroccan locust (which they fought largely by the Cyprian barrier method), the nun moth, the Hessian fly, the frit-fly, the grain saw-fly, the grain aphid, clover weevils, and the sugar-beet beetle.

Sajo resigned in 1894, and in 1896 Horvath was transferred to the National Museum, Jablonowski remaining as acting director with one assistant. A little later, he was sent to western Europe for study. On this journey he visited Italy, France, Holland, Belgium, Germany, and Switzerland. While on this journey he received his appointment as chief of the station, and retained the position until the present year (1928) when he was retired for age.

During the years of his incumbency of the office, Jablonowski not only did admirable work but grew rapidly in the eyes of the scientific men of the world and was an important factor in the rather remarkable change that has occurred in Europe as well as elsewhere in the esteem in which economic workers in entomology were and are held. I well remember that when, on my first visit to the Hungarian National Museum in 1902, I asked Mocsàry and Kertész where I could find Jablonowski, the reply was "Why do you wish to see Jablonowski? He is not a scientific man; he is an agricultural entomologist—a kind of farmer." What a change since then! Not only is the economic entomologist today recognized among the men of

science, but he is responsible for many important discoveries and for a strengthening of the esteem in which all scientific men are held in the eyes of the general public. He is responsible for larger funds to the museums and for governmental appropriations for the support of much scientific work. In this remarkable change Jablonowski has been an important factor, and I was not at all surprised to note the high esteem in which he was held at the Third International Congress of Entomology in Zurich in 1925 and at the Tenth International Zoological Congress at Budapest in 1927.

As is obvious from this, his administration of his office in Pesth was very successful. He not only speedily established the confidence of the agricultural public of Hungary in the value of his work, but made his name known throughout the Empire and in fact throughout Europe. His early work on the animal pests of sugar beets resulted in a great increase in the growing of this crop and in the number of sugar factories owing to the fact that he discovered how to control a beetle known as *Cleonus punctiventris*, a species that occurs only in Hungary and southern Russia. He also published two large treatises entitled "The Injurious Animals of Fruit-Trees and Grapes" and "The Protection of the Fruit Orchard." Later he published another work on "The Animal Pests of the Hop."

As to the Hessian fly, he early advised the late planting of wheat in those parts of Hungary where this insect had become a pest; and his investigations of *Zabrus gibbus*, the larvae of which destroy young grain and the adults of which feed upon the grain before it ripens, showed the value of crop rotation. Other successful investigations were carried on, and Jablonowski has behind him a record of extremely fine and successful work.

To us in Washington he has always been one of the most helpful of the European workers. In the early part of the century I visited him several times in Budapest, and we grew to be very fast friends. He was the first person to point out to me the overwintering of the larval parasites of the brown-tail moth in the nests of the young larvae; and owing to this suggestion we were able to import thousands of these winter nests and to establish in this country certain very effective enemies of the brown-tail moth which have undoubtedly aided greatly in the control of this pest and in the prevention of its spread beyond the region that it inhabits in New England. Then too, when the European corn borer was discovered to have established itself firmly in this country, we appealed to Jablonowski for full information as to this insect in southern Europe. During a desperate time in his country, when the Bolsheviks under Bela Kun were in control, he prepared a long and important manuscript that was of

great service to us during the early years of the investigation. Much later he has welcomed to Budapest and has assisted with advice and in other ways the experts of the United States Bureau of Entomology who have been sent out there on different missions, especially, however, connected with the study of the ecology of the corn plant and the European corn borer and with the European parasites of the gipsy moth.

A short time before the war he translated into Hungarian from the English my book entitled "The House Fly, Disease Carrier," and, although it did not appear until 1917 (we had gone over the subject carefully together at Oxford, England, in 1912), it met with a hearty reception. It appealed to the intelligent class of people and became a popular reader for students in high schools and colleges. Jablonowski wrote me in 1928 that there are still two or three copies available for circulation in many of these schools but they are pretty well worn out by constant use and frequent reference.

During the summer of 1928, resting and recuperating in the so-called Black Forest of Hungary, Jablonowski wrote me a long and charming account of his life, which I hope will be published some day. His health had remained almost perfect down to 1927, and then he had all sorts of trouble which he epitomized as follows:

After 37 years of service, I became seriously sick. My diabetes became worse and worse, and a serious ear trouble landed me on the operating table. Arteriosclerosis threatened to become very serious, and I nearly lost my voice on account of a severe throat trouble. What else does a man need to make his life miserable? I had reached my 65th year of age without any serious sickness; but in my 66th year not less than 19 physicians tried their skill on my body. Thanks to the Lord and to the physicians, I am still alive and able, as you see, to write this long letter to my dear old friend.

This account of Hungarian economic entomology is so far a one-man affair, but this is proper, since economic entomology in Hungary for many years has meant Jablonowski almost solely. But of late years excellent work has been done by two younger yet still mature men, namely G. Kadocsa and G. Bako. I imagine that Kadocsa must have succeeded Jablonowski when the latter retired in 1928. The offices and laboratories where the economic work is being done are in the old city of Pesth at a very considerable distance from the national collections in the Hungarian Museum on the other side of the river, in Buda. This is unfortunate, but the laboratories are well equipped, and at the time of my last visit contained large collections of injurious species. There can be no doubt that the present Hungarian Gov-

ernment appreciates the value of work in economic entomology, and that the investigations of Jablonowski's successors are being cordially supported.

For several years prior to 1928 the United States Bureau supported a parasite laboratory in Budapest under the direction of C. F. W. Muesebeck, and this laboratory was conveniently located at a comparatively short distance from the headquarters of Government economic entomology in old Pesth. The headquarters of the ecological investigations of the European corn borer, under K. W. Babcock, were also maintained for a time in Budapest.

DENMARK

Although Denmark since the time of Fabricius has given the world a number of well known and even famous entomologists, and although for centuries agriculture has been the chief industry of the country, agricultural entomology is comparatively new there. It is not so old, in fact, as in Sweden and in Germany. In spite of the fact that forestry in Denmark is of much less importance than agriculture, forest entomology appeared before agricultural entomology, and the latter did not begin to develop until the last decade of the last century. This rather anomalous fact was due to the early organization of higher instruction in forestry in connection with the Universities of Copenhagen and Kiel.

The first Dane to study forest entomology was J. C. Schiödte, who was appointed teacher of zoology at the College of Forestry in 1858 and in 1863 went to the Royal Veterinary and Agricultural College where he served as Docent in general zoology and forest zoology until 1883. His economic publications are few and not very important, and he did not seem to be especially interested in questions of control.

He was succeeded in the latter position by Frederik Meinert, who retired in 1885. In the meantime Schiödte had been appointed Curator of the Zoological Museum, where he was also succeeded by Meinert.

In the latter half of the last century there were severe attacks by insects in the plantations of conifers in different parts of the country, and in 1857 F. C. Eide published a paper on these insects. Forest insects were further studied by H. Borries, who made excellent studies, especially of the saw-flies; and in 1898 E. A. Lovendahl wrote an admirable memoir on the Danish bark-beetles.

Meinert was succeeded as Docent of Zoology in the Veterinary and Agricultural College in 1885 by J. E. V. Boas, who retired re-

cently (1927). Boas is probably best known for his studies in the comparative morphology and phylogeny of vertebrates and Crustacea, but he made many remarkable investigations in applied zoology. His studies of the cockchafer which were enormously destructive on farm lands, in gardens, and in nurseries, led to the passage of a bill requiring the collection of the adult beetles, that became a law in 1887. In 1887, 7,500,000 Danish pounds of the insects were collected, and the number was steadily reduced year after year until in 1903 only 8,000 pounds were collected. He did not, however, attribute this enormous decrease in number entirely to the destruction of the adults. After a number of important papers on forest insects, he published his "Danish Forest Zoology" in 1896 which is doubtless one of the best textbooks of the kind in existence. It is admirably illustrated and full of the personal observations of the author. It is notable for its sharp criticism of many unfounded opinions and worthless measures.

In addition to his work in forest entomology, Boas lectured before the veterinary students on the parasitology of domestic animals, and he is said to have been largely responsible for the adoption of a system for the rational control of the warble-fly by the compulsory extraction of the larvae from the backs of cattle all over the country. A government act was promulgated in 1923 establishing this process. It is said that the operation of this act means at least 5,000,000 kroner saved to Denmark each year.

Pioneer work in agricultural entomology was done by the botanist, Emil Rostrup, who, while Professor of Phytopathology at the Veterinary and Agricultural College, published each year from 1885 to 1905 a survey of diseases and insect pests on farm crops. In the 1890's his daughter-in-law, Mrs. Sofie Rostrup, took up the study of agricultural entomology and in 1907 was made Zoologist to the cooperative Danish agricultural associations. In 1913 an Institute of Phytopathology was founded under the leadership of K. Ravn, the successor of E. Rostrup, and Mrs. Rostrup was appointed Zoologist. But it was not until 1921 that this Institute was provided with suitable laboratories. Mrs. Rostrup remained Chief Zoologist until 1927. During this period she wrote many papers on insects and nematodes, and in 1920 published a book entitled "Noxious Animals of Our Agriculture." The fourth edition of this book appeared in 1928, this last edition being done cooperatively by Mrs. Rostrup and Dr. Mathias Thomsen who succeeded Boas as Professor at the Veterinary and Agricultural College. Mrs. Rostrup's work has been very sound, and more than that, it has been broad. In addition to her

studies on the life histories of injurious insects, she has investigated the effect of the insect on the host plant, the influence of various external conditions such as climate and soil, the degree and duration of the attack, the influence of different methods of cultivation on the resistance of the plants, and finally the direct technical control.

In 1927 she retired from her official position and was succeeded by Prosper Bovien who is now studying the nematodes of cultivated plants.

Dr. Thomsen, in the Veterinary and Agricultural College, and Professor Daniën, in the Institute of Phytopathology, have the future of Economic Entomology in Denmark largely in their hands at present. If they are allowed to direct and control the character of this work we may expect excellent results.

HOLLAND

Holland, through its early and extraordinary commerce, came in contact with all the then known faunas and floras of the world, and from the earliest times its navigators brought home all sorts of strange specimens in natural history. It results naturally, therefore, that there were early writers on insects in that country. The famous names of Goedart, Swammerdam, van Leeuwenhoek, and Lyonet are Dutch, as are those of Cramer, Sepp, and very many of the later writers of note. An admirable review of Dutch entomology was given by Dr. J. B. Caporal at the Fourth International Congress of Entomology in August, 1928, and has been published in the proceedings of that Congress.

It was not, however, until J. Ritzema Bos came on the scene that economic entomology began its development in that country. In 1895 he was drawn from his position as Instructor in Zoology at the Government Agricultural School at Wageningen and was made director of a phytopathological laboratory in Amsterdam which had been founded by the horticulturists. At the same time he was made Professor of Plant Diseases at the University of Amsterdam. In 1899 a Government phytopathological service was established for Holland, largely through Ritzema Bos' efforts, and he was made its head. In 1906 an Institute for Phytopathology was formed in the Royal University for Agriculture, Horticulture, and Forestry at Wageningen, and Ritzema Bos was made its Director. This Institute was replaced by the Agricultural College in 1918. While not distinctively an entomologist, but rather an agricultural zoologist, he had charge of the economic work for the State in entomology, and also taught this

subject. His well known books, "Agricultural Zoology" and "Text-book of Zoology," were republished in Germany and in England.

When Ritzema Bos left Amsterdam, Dr. J. C. U. de Meijere became Privatdocent in the science of Arthropods (especially insects and their economic importance). In 1908 he became Extraordinary Professor in Economic Zoology. From this time until 1921 he taught this subject and conducted experimental work in the zoological laboratory of the University and in a large garden.

At Wageningen, Ritzema Bos was joined by Dr. H. M. Quanjér who took up plant diseases. In 1909 P. van der Goot was appointed an assistant and entered the entomological work, but in the same year went to the Dutch East Indies. While in Amsterdam, however, he wrote an admirable monograph of the Aphididae of Holland which was later published (in 1915). A little later N. van Poeteren and T. A. Schoevers joined the staff, and in 1912 C. A. L. Smits van Burgst was appointed Entomological Adviser to the institution.

The greatest change, however, took place in 1919 when the phytopathological service was separated from the Agricultural College on account of its growth and became an independent organization directly under the Department of Agriculture. In 1920 Ritzema Bos resigned on account of age. At present the service is divided into phytopathological and entomological branches, Doctor Quanjér being in charge of one and Dr. W. Roepke in charge of the other. Doctor Roepke had spent nearly 12 years in the Dutch East Indies, engaged in work in economic entomology on tropical agriculture. He is assisted by Dr. G. F. Betram, a graduate of Leyden, and the laboratory is now working on insects of economic importance both for Holland and for its tropical possessions.

My information is derived from Doctor Caporal's address and from correspondence with Professor de Meijere and Doctor Roepke.

The geographic extent of the tropical possessions of the little country Holland is not generally understood. In land surface they almost equal the size of the United States. The problems in economic entomology in these tropical possessions are very serious indeed, and this applies, naturally, not only to agricultural entomology but also to medical entomology. The Dutch investigators who have been sent out to these tropical possessions are well trained men, and they have done very valuable and very serious work in both branches of economic entomology.

I first met Ritzema Bos in 1898, under somewhat peculiar circumstances. The German Government had recently promulgated its decree barring American fruit from entrance into Germany, on ac-

count of the danger of importing San Jose scale. Other European governments became immediately interested, Holland among them. Before issuing a decree, however, the Netherlands Government sent its leading expert, Ritzema Bos, to the United States to investigate the seriousness of the trouble. He arrived in Washington and, calling at the office, learned that I was in California. He was given my address in San Francisco, and immediately started for the Pacific Coast under the impression that a journey in the United States, while longer than a journey in Holland, was still not the serious matter that it proved to be. After a continuous train journey of 6 days (3,000 miles) he arrived at San Francisco late at night, and early the next morning sent his card to me at the old Occidental Hotel, and we took breakfast together. We talked for possibly an hour about the situation. I was very keen on the San Jose scale question at the time, and told him all that he seemed to wish to know. An hour later he took the train back to New York, and from there the vessel to Holland.

In 1902 I called on him at his Amsterdam laboratory, and found him to be the extremely courteous, highly placed, well informed man that I had supposed him to be from his reputation and from our brief interview in San Francisco. On later visits to Europe I saw him at work in his laboratories at Wageningen, where he was evidently esteemed as a man of the highest standing and of great importance.

In 1907, on my return from south Russia, I attended the meetings of the Seventh International Congress of Agriculture at Vienna, and at the meeting of the Section of Economic Zoology I found Ritzema Bos in the chair. The subject under discussion was the value of birds to agriculture, and the chairman invited me to take part. I explained the important investigations being carried on by the Biological Survey of the Department of Agriculture at Washington, and insisted that such an investigation should be carried on in European countries before decrees should be promulgated for the protection of all birds.

In 1921 Ritzema Bos again visited the United States, in the interests of the Dutch bulb growers and in protest against Quarantine No. 37 of the Federal Horticultural Board. I told him about the work of the Bureau and introduced him to the workers here. In the Visitors' Book of the Bureau he is registered as ex-Professor of Entomology and Phytopathology and ex-Chief of the Holland Phytopathological Service. He had already at that date retired from official work.

Again in 1923 I saw him at the International Conference of Phytopathologists and Economic Entomologists at Wageningen. He took no active part in the proceedings, but on my mentioning his name in my opening address it was greeted with loud applause, and later, when he entered the room, every one arose. In 1925 he had evidently failed in health and was much less vigorous than he appeared to be in 1921.

He died at Wageningen, Holland, on the night of April 6, 1928. We were very warm friends, and it is a cherished thought that the last thing written by him was an article about my 70th birthday which was published the week after his death, in a Netherlands scientific journal edited by Doctor Schoevers.

Referring to the International Conference of Phytopathologists and economic entomologists held at Wageningen in 1925, I believe that the quarantine above referred to had something to do with the choice of myself as honorary president of the Conference. However, such a choice had not the slightest influence upon the quarantine attitude of the United States Government. Of course, I had no connection with the Federal Horticultural Board, and in fact no one connected with the Board was at the Conference. The meeting itself, however, was of interest and importance. In the first place, it brought together the phytopathologists and the economic entomologists as independent though cooperative groups. This was eminently proper and was the first indication of the proper use of the term "phytopathology" by a European organization. In addition to its rather unique scope, the assemblage was notable from the fact that the Central Powers were represented by delegates for the first time since the World War. France was represented by Marchal, Mangin, Foëx, and others, Germany by Appel and others, and Belgium by Van Hooze and Mayné. It was a notable conference from many points of view. Its organization was made continuous, and subsequent international conferences of this precise kind will undoubtedly be held. We visited many points in Holland and were greatly impressed by the remarkable cultures and their intensive and cleanly character.

As to the work of the Hollanders in the Dutch East Indies, their work in everything relating to agriculture has been sound and enterprising and their experimental work, especially in the great botanical station at Buitenzorg, has long been the admiration of specialists. In their extensive sugar cane and tobacco work in Java and Sumatra they soon encountered the question of insect damage and some ad-

mirable men have been sent out there from time to time to study questions of this kind.

The entomological service in Washington was appealed to by these men for assistance of one kind or another at a comparatively early date. My own correspondence with L. Zehntner, who among other things studied the parasites of sugar cane insects, surely began as early as the late 1880's. The relations of the United States Department of Agriculture with the Dutch East Indies became closer after David Fairchild went out there for study in 1896.

A notable event was the visit of L. P. de Bussy, Zoologist of the Experiment Station at Deli, Sumatra, to the United States in 1910, in the effort to arrange for the shipment of parasites of *Heliothis armigera*, a polyphagous species, to the East Indies where its larvae were damaging the tobacco plantations. I went with De Bussy in midsummer across the country to San Francisco and down through the South to Texas where he arranged to have certain parasites studied and shipped to the Orient. De Bussy was and is a charming fellow, well trained as an economic zoologist and after serving his time in the Dutch East Indies he became Director of the Zoological Department of the Colonial Institute at Amsterdam. K. W. Dammerman and P. van den Goot have been capable workers in economic entomology in Java and Sumatra since De Bussy's time. Both have visited Washington, the former in 1917 and the latter in 1918. The admirable work in economic entomology in the Dutch East Indies will be treated in more detail in a later section.

BELGIUM

Belgium is the home of many excellent entomologists and of one of the best entomological societies of Europe. Excellent entomological work has been done in that country for very many years. One of the most noted of the European entomologists, Baron M. E. de Selys-Longchamps (1813-1900) was for many years the world authority on the Odonata. Prof. A. Lameere, the President of the First International Congress of Entomology, is a well known writer on many of the broader topics in entomology and is still living in Brussels. The country is small, the fields are small, and the cultivation is intense. Therefore, the problems in economic entomology are not extremely serious, even as regards forestry. Belgium, however, has large possessions in Africa, where the insect problem at once becomes serious when the cultivation of crops is begun.

In 1860 the Institut Agricole de l'État was established at Gembloux under the direction of Phocas Lejeune. In 1864 was published the

first important article on economic entomology in that country. It appeared in the *Bulletin de la Federation des Sociétés d'Agriculture* and was entitled (translated) "A Treatise on Horticultural, Agricultural, and Forest Entomology and Methodical Treatment of Injurious and Useful Insects, Comprising Their Description, the History of Their Habits and Mode of Life, and the Means of Destroying Those that Damage Cultivated Plants." The author was Alfonse Dubois. It is a paper of over 200 pages, and is illustrated by four admirable colored plates. There is little in it of value, however, in the way of remedies.

In 1891 was begun at Gembloux the publication of the *Journal d'Association des Anciens Élèves de l'Institut*, and in 1893 this journal published its first entomological article. It was entitled "Entomologie Forestière" and was signed "Dubois, Ingenieur agricole, Garde Général Adjoint, Eaux et Forêts à Bouillon." And in the same year a brief report on insects by J. Poskin was reviewed. The title of the journal was changed in 1897 to *L'Ingénieur agricole*, and the volumes for 1897 and 1898 contained two brief articles signed, the one by A. de Wilde and the other by Servais. Later the name of the journal was again changed, this time to *Annales de Gembloux*, and has continued publication under this title.

In 1894 a phytopathological organization was instituted at the State Agricultural Institute of Gembloux, and comprised two branches, one entomological and the other cryptogamic. The head of the entomological branch was Prof. J. Poskin, Professor of Zoology and Entomology, Prof. E. Marchal taking charge of the cryptogamic work and holding at the same time the position of Professor of Botany at the Agricultural Institute. In a report presented by Professor Marchal at the Eighth International Congress of Agriculture at Vienna in 1907 I learn that the function of this service was to instruct the farmers concerning plant injury, to identify specimens and to indicate remedies; also to keep track of the damage and to conduct experimental research. Wherever the ravages were important and general, specialists were sent out to visit the field. Professor Marchal showed that specimens and queries concerning injurious insects had been received in increasing numbers—31 in 1894 and 235 in 1905.

In 1904 was published at Brussels, in English, a pamphlet entitled "The Government Agricultural Institute of Gembloux—History, Organization, Instruction, Annexes." Under the head of Zoology and Entomology, the following paragraph occurs: "The course in zoology taught successively by Mr. Malaise, Professor of Natural Science, and since 1888 by Mr. Warsage, Assistant Lecturer in Zoo-

techny, became in 1891 independent and was entrusted to Mr. Poskin, Doctor of Natural Science, who was commissioned to give to entomology, which was then sadly neglected, its true importance in natural science."

True work in economic entomology, therefore, may be said to date from 1891 when this commission was given to Professor Poskin.

Professor Poskin published a series of reports (probably annually—I have not seen them all) that contained many interesting and important short articles. In the *Annales de Gembloux* for 1907 is published a very important address delivered by Professor Poskin at the solemn séance of the opening of the academic year, on entomology in its applications to agriculture. It was a very competent address showing familiarity with work done in other parts of the world and especially in the United States, urging among other things the use of arsenical sprays. Dwelling upon the importance of the subject he says (translated) "Can one treat as a negligible quantity an almost microscopic creature that in the course of the year will kill 1,500,000 trees?" After further detailing many facts, he uses the significant words (translated) "It would be puerile to exaggerate the importance of this problem, but it must be done to indicate the general ignorance of the people."

In the volume of these *Annales* are to be found numerous articles on applied entomology. In 1905, for example, was published an account of the frit-fly by Alb. Carlier.

Professor Poskin was still writing in 1921. In that year he published in the *Annales* an article on silviculture and agriculture.

Rather serious damage to forests by insects occurred toward the latter part of the last century, and the Superior Council of Forests of Belgium found itself confronting a condition which demanded serious attention. Prof. G. Severin, then Curator of the Royal Natural History Museum in Brussels, was officially charged by the Government to study the situation, and for some time he paid much attention to forest insects. It was while he was engaged in this work that I first met him in Brussels in 1902. Severin was and is (he is still living) a very unusual man. His work in the Museum at Brussels has always been of a very high character, and he has concerned himself with the study of several groups of insects. He acted as the scientific executor of De Selys-Longchamps and brought out a beautiful edition of his completed writings on the Odonata. The Natural History Museum in which he was Curator is one of the best planned museums of the kind in existence. In no other natural history museum has the same attention been paid to the arrangement of the exhibits

of animals on a magnificent evolutionary scale. Fortunately, Professor Severin came to the United States in 1907, to attend the International Congress of Zoology, and at that time, on account of his authoritative position regarding forest insects, he was asked to give an expert opinion to the Massachusetts State authorities on the value of the work then being done to introduce from Europe the parasites and other natural enemies of the gipsy moth and the brown-tail moth; and his report, together with those of Dr. Geza Horvath of Budapest, Dr. R. Heymons of Berlin, and others, was of such a character as to squelch the demand that had arisen in certain quarters in Massachusetts for the abandonment of the methods then in use and the employment of a California collector of parasites.

At the First International Congress of Entomology, held in Brussels in 1909, Severin was one of the leaders. And I had the pleasure of journeying with him from Brussels to Oxford in 1912 to attend the Second Congress. During the World War, when the Germans constantly occupied Brussels, he stayed in the Museum constantly day and night watching lest the collection should come to harm. The last time I saw this fine man was in 1925. He had then retired from the Museum and was lecturing on medical entomology at the School of Tropical Medicine near Brussels.

The School of Tropical Medicine, by the way, was established largely for the purpose of teaching about tropical diseases to the young men who were to go out to the Belgian Congo to care for the families of the European administrators and colonists as well as the native population. And this statement leads us naturally to the consideration of work in economic entomology in the Belgian Congo.

I am not quite sure about the beginning of the entomological service in the Congo, but I note that R. Mayné served there for a number of years (approximately from 1916 to 1921) and published a number of very good reports on the insects of that region. J. Ghesquière has also apparently been resident in the Congo for many years, and now holds the title of Government Entomologist. Dr. H. Schouteden, the well known Belgian entomologist, now I believe connected with the Colonial Museum at Brussels, has written upon several Congo insects, notably the coffee berry beetle (*Stephanoderes hampei*) and the other beetle enemy of the coffee berry, *Araccerus fasciculatus*. Moreover, Mr. E. Hegh, in the Agricultural Bulletin of the Belgian Congo, published in 1920 two installments of a monograph on the termites of tropical Africa written with the object of making known the methods of distribution.

Apparently R. Mayné succeeded Professor Poskin at the station at Gembloux. In the October, 1922, number of the *Annales* previously referred to he has an article entitled "Organization of International Measures for Entomological Protection." In this article he refers to Monsieur Ghesquière as Entomologist of the Colony of Belgian Congo. In the *Annales* for December, 1923, Mayné has an article entitled "Principal Enemies of Coffee in Belgian Congo," and in the number for May, 1924, another one on the Colorado potato beetle, suggested by the appearance of this injurious insect in west France. In the October-November number for 1926 he has an illustrated article on *Pissodes* in Belgium.

It is interesting to add that there was published in 1920 a report on the operations of the entomological station from 1913 to 1919, written by Professor Poskin. The title attracted me because it covers the period of the World War and the period of the occupation of a large part of Belgium by the Germans. In the report there is no mention of the war, and the only possible reference to the disturbance occurs in the opening sentence concerning the year 1915, in which the statement is made that the activity of the service, completely ruined beginning with August, 1914, began to show signs of life in 1915.

Added note.—As this is going through the press, I have received a ten page manuscript from my friend Professor R. Mayné, entitled (translated) "Economic Entomology in Belgium and the Belgian Congo." I am very sorry that I did not receive this manuscript at an earlier date and I earnestly hope that my friend Mayné will publish it in Belgium.

For the purposes of this book we may add a few statements gained from this article which may supplement what already appears above.

Mayné attributes the great impulse to applied entomology to Jules Poskin and G. Severin, which eventually resulted in the royal decree attaching the entomological service to the state Agronomical Station at Gembloux in 1909, and the later decree of 1912 reorganizing the central agronomic station. J. Poskin was the first director of the entomological station and was followed in 1921 by Raymond Mayné who had been his assistant the previous year.

In 1910 occurred a reorganization by M. Leplae, Director General of Agriculture of the Belgian Congo. The positions of entomologist and mycologist were created and Mr. R. Mayné instituted an entomological laboratory in 1911 which in 1913 was transferred to the Botanical Garden of Eala, where a mycological laboratory had already been installed by the late Dr. Canille Vermoesen. Mayné's studies

began with the enemies of cocoa, coffee, rubber, cotton, and the coconut palm. The important collections of insects were classified by Dr. H. C. Schouteden.

In 1916 J. Ghesquière was sent out as a second entomologist and worked in the province of Katanga. In 1919 Mayné's health broke down and he returned to Belgium where he assumed the directorship of the state entomological station. The laboratory at Eala was then placed in charge of Ghesquière who transferred it to Stanleyville and took up as his specialty questions relating to cotton.

In 1921 Seydel was made entomologist to the province of Katanga and established an important laboratory at Elizabethville. Ghesquière left in 1924 and Seydel remained until 1929. In 1929 five entomologists were named for the Congo, one for each province, each one reporting to the provincial station. The provinces are: Bas-Congo, and Kasai, Province Orientale, Province Equatoriale, Katanga, Ruanda-Urundi. At present there are three entomological officials, viz., Seydel for Katanga, M. Bredo (1929) for the equatorial province, and Jean Vrydagh (1930) for the oriental province.

This note refers only to persons and stations. Professor Mayné adds in his manuscript a number of interesting facts about the work and also a complete bibliography. This should be published soon.

SWEDEN

Dr. N. A. Kemner, at present Director of the Entomological Department of the University of Lund, has been kind enough to send me a careful statement concerning applied entomology in Sweden, and it is from this statement that the following paragraphs have been prepared; many of them are printed here practically in Doctor Kemner's phraseology.

Applied entomology is very old in Sweden. Doctor Kemner reminds me that Linnaeus himself was the first one to publish a comprehensive synopsis of this subject, in a paper entitled "*Noxa Insectorum*" printed at Stockholm in 1752. This was probably the first paper on applied entomology prepared by a thoroughly scientific man. It gives a good summary of insect damage and mentions a large number of the most injurious insect pests of the field, garden, and household. In a recent paper entitled "*Linné als Praktischer Entomologe*" (pp. 1-104, Stockholm, 1924), Felix Bryk gives the results of his studies of Linnaeus as an applied entomologist, showing that the great author published many good observations on noxious insects. Bryk gives extracts.

A contemporary of Linnaeus, the Rev. Clas Bjerkander (1735-1795), wrote about 26 papers on noxious insects, mainly on pests of grain, and was the first to describe a number of the most important enemies of grains. In 1877 he published an important paper on *Siphonella pumilonis*, and in 1778 a paper on *Hadena secalis* and *H. tritici*. In 1779 he published for the first time about wireworms, and in 1790 about thrips. His papers were full of good field observations, and were soon translated into other languages. At this time also there were many other workers who occupied themselves to a certain extent with injurious insects. The physician, A. Beck, and Prof. M. Strömer wrote about *Charaeas graminis* (1741 and 1742); D. Rolander on *Hadena secalis* (1752); and the Professor of Chemistry in Upsala, T. Bergman (1735-1784) about *Cheimatobia brumata*. This paper, printed in the year 1763, is of importance because it proposes for the first time the method of tarred wrappers on the trunks of the trees. Dr. Kemner thinks that Bergman also can be regarded as the inventor of lime girdles against *Cheimatobia*. The last decades of the eighteenth and the first of the nineteenth centuries were less interesting in Sweden from the standpoint of economic entomology. But in the year 1837 was published Dahlbom's excellent work, "Kort underrättelse om skandinaviska insekters allmänare skada och nytta" (Lund, 1837) (= "Short information about the damage and utility of Scandinavian insects"). Dahlbom (1806-1859) was lecturer in entomology at the University of Lund, a friend and disciple of the famous dipterologist, Zetterstedt, and himself a well known worker on certain Hymenoptera. His book on the noxious insects is, for that time, a good synopsis of applied entomology, and he must be ranked with the contemporary German authors on the same subject, Bouché (1833) and Ratzeburg (1837).

After Dahlbom, A. E. Holmgren was the leader of applied entomology in Sweden. He was a specialist on the Ichneumonidae, and was lecturer on natural history at the Institute of Forestry in Stockholm, teaching practical entomology both there and (during his vacation) at the Agricultural School at Alnarp. He did a great deal to popularize entomology in Sweden, and wrote three handbooks on economic entomology—in 1867, a "Forest Entomology"; in 1873, an "Agricultural Entomology"; and in 1880, a "Manual on Household Insects." All these books were influenced by foreign works on the same subjects, but they all contained good original observations made in Sweden.

Down to this time economic entomology had no official governmental standing in Sweden, and the papers on the subject were all

written by persons who followed it as a vocation additional to their regular work. The Royal Academy of Agriculture of Sweden had previously recommended the appointment of a Government entomologist, but was not successful until the year 1880, when the Government appropriated 1,000 kroner as an annual salary for an entomologist to work under the direction of the Academy of Agriculture and whose duties should be to disseminate information on injurious insects. The first appointee under this appropriation was Dr. A. E. Holmgren. He worked as State Entomologist until 1887, and died in 1888 at the age of 69.

Dr. Holmgren was succeeded in 1887 by Sven Lampa, who was a self-made man, working as curator of entomology in the Museum in Stockholm. Between 1887 and 1897 he did excellent work as Holmgren's successor as State Entomologist. He traveled extensively and studied insect outbreaks, especially those of the grain flies, the cockchafer, the grassworm, the rape-beetle, and so on.

The Entomological Society of Sweden, founded in 1879, almost from its beginning began to stress the importance of economic entomology, and its efforts were strongly supported by the Royal Academy of Agriculture, by the Economic Society of Ostrogothia, by the Bureau of Agriculture and other agricultural associations of Sweden. They urged the establishment of an entomological experiment station which should be well outfitted and amply supported.

In 1891, under the auspices of the Entomological Society of Stockholm, Lampa, Aurivillius, Sjöstedt, and others, an important journal entitled "Uppsatser i Praktisk Entomologi" ("Articles on Applied Entomology") was started. In this publication many notices and articles on Swedish economic insects were printed, and here Lampa published his annual reports on injurious insects.

An institute for practical entomology was finally organized in 1897. Lampa was appointed Professor and Principal Director, giving up his work in the Museum. He continued his work on applied entomology in the new institution until 1907, when he retired at the age of 70 years. He then lived in Stockholm and later in a community near by, where he died in 1914. Aurivillius says of him (*Entomologisk Tidskrift*, 1915): "Lampa was a born friend of nature, with a pronounced practical disposition which became developed still further by his unusual course of life. He had little consideration for theories that were not based upon practice and experience, and he knew how to refute them with characteristic remarks."

Lampa published a large series of articles (Aurivillius enumerates 210), and his work was greatly appreciated by the practical farmers.

He showed them the practical importance of entomology. In 1907 he was succeeded by A. Tullgren, who has carried on the work of his predecessor in a very satisfactory way and has published a number of sound papers. He has now the title of Professor.

In the early part of Lampa's service under the State Agricultural Experiment Station, Dr. Yngve Sjöstedt was his first assistant until 1902, when he became the successor of Professor Aurivillius at the Royal Museum of Natural History at Stockholm. Tullgren became Sjöstedt's successor at the Experiment Station. When Tullgren succeeded Lampa (in 1907) as Director of the Agricultural Experiment Station, Dr. Ivar Trägårdh became the assistant. Previous to 1909 he had been teaching entomology at the University of Upsala.

In 1915 the system of education in forestry was reorganized, and a Forest Entomological Laboratory was attached to the Forest Experiment Station, Doctor Trägårdh being made the chief of this laboratory. In 1921 the Entomological Laboratory was made an independent department of the Station; Doctor Trägårdh was made a professor and was given an assistant, Doctor Spessivtseff, a well known authority on bark-beetles, formerly an assistant in St. Petersburg to Cholodkovsky and therefore a Russian refugee.

Doctor Trägårdh has done extraordinarily good work with forest insects. He is a broad and sound man, and is acknowledged to be one of the world's leaders in this field. Personally he is well known to a great many entomologists, and has been able to attend the international congresses. During the summer of 1928 he came to the United States and traveled extensively, visiting particularly the points of especial interest in forest entomology.

When Trägårdh left the Agricultural Experiment Station in 1915, Dr. N. A. Kemner was made first assistant there, and in 1921 entomologist. From this year there were also two trained assistants, namely Dr. O. Lundblad and O. Ahlberg. In 1929 Doctor Kemner was made Director of the Entomological Department of the University of Lund, and Doctor Lundblad then became entomologist. Under the Agricultural Experiment Station, Professor Tullgren published an account of insect injuries 1911 and 1912-1916. The report for 1917-1921 was published over the names of O. Lundblad and A. Tullgren; that for 1922-1926 by O. Lundblad.

Besides the workers already mentioned, all of whom have occupied professional positions in applied entomology and whose many papers have been published in the authorized records, there has always been a number of scientists not professionally engaged in applied entomology who occasionally have written good articles on the subject.

Among them should be mentioned Doctor Hedlund, Professor at the Agricultural School in Alnarp, who has done research work on *Hylemyia coarctata*; the famous geneticist, Prof. Dr. H. Nilsson-Ehle, at Svalöv, who has made many observations on economic insects and nematodes in grains; Dr. Simon Bengtsson, until 1929 Director of the Entomological Department of the University at Lund, who has made a special study of the nun moth in Sweden; the physician, Dr. John Peyron, in Stockholm, who has investigated *Cheimatobia brumata*; Dr. Eric Mjöberg, who has published a monograph on lice; the Professor at the Veterinary High School of Stockholm, Dr. Arvid Bergman, who has made extensive studies on the Oestridae of the reindeer, and so on.

I have long had a great admiration for Swedish entomology. My early studies of the parasitic Hymenoptera led me to carefully work with C. G. Thomson's Hymenoptera Scandinaviae, Volumes 4 and 5, in the course of which I picked up a translating knowledge of the Swedish language. In 1897 we were greatly pleased to receive a visit in Washington from Dr. Yngve Sjöstedt, who spent some time studying the organization and work of the entomological service of the United States Department of Agriculture and the collections of the United States National Museum. I have no doubt that it was through Doctor Sjöstedt that in 1898 I was made an honorary member of the Entomological Society of Stockholm. This was the first honorary membership in a foreign society that had come to me, a notable thing in itself, rendered still more notable by the high character of the Society. Fifteen years later I had the pleasure of meeting Doctor Sjöstedt at the Second International Congress of Entomology at Oxford in 1912, and still 13 years later I met him again at the Zurich congress. In the intervening years Doctor Sjöstedt had gained a very high place in the scientific world and was highly esteemed both at home and abroad.

Even before Doctor Sjöstedt's visit, Dr. Filip Trybom visited us in Washington; in fact, as I see from my notes, it was away back in 1886. Doctor Trybom at that time was interested in some fisheries question, but he had been studying the Thysanoptera and was anxious to talk over things with Theodor Pergande here, who was also studying thrips. Trybom was here for several days, and when he came in the last time he said to Pergande, "I am going to California; is there anything I can do for you out there?" Pergande replied, with a twinkle in his eye, "No, unless you get me some of those thrips from the tops of those big California trees." Trybom was stumped for a

moment, but replied, "How can I—But then, I have a good rifle along with me!"

Doctor Trägårdh, as previously mentioned, I met first at the International Conference of Economic Entomologists and Plant Pathologists at Wageningen in 1923, again at Zurich in 1925, and still later in the United States in 1928.

These are the only Swedish entomologists I have had the pleasure of knowing personally, but I have followed the work over there with the greatest interest, and had an especial admiration for Dr. Christopher Aurivillius who by correspondence helped me in several emergencies, among other things giving me information enabling the settling of the priority question concerning certain economically important genera of parasites established under different names by Thomson and G. Mayr.

NORWAY

Prof. W. M. Schoyen (1844-1918), having graduated at the Agricultural College in Aas, became greatly interested in agricultural entomology, abandoned his early intention to study medicine, and took a position in the Zoological Museum in Christiania, where he worked for 10 years. He became favorably known as a scientific worker through his papers on Norwegian Lepidoptera, Hemiptera, Orthoptera, and Diptera, and he also published an occasional paper upon injurious insects. In 1891 he was appointed by the Government "Landbrugs-entomolog" and parliament voted him an annual salary of 1,000 kroner (\$270). He corresponded with farmers and horticulturists, and in 1891 published an annual report, and in the next year issued another one. In 1893 his salary was raised to 1,200 kroner, and in 1894 he was appointed Government Entomologist and was given a salary of 3,000 kroner with traveling expenses. He was instructed to study insects and fungi in their relations to agriculture and horticulture as well as to forests. Admirable reports were published by Schoyen annually from 1891 and all bore the same title, "Beretning om Skadeinsekter og Plantesygdomme." Beginning with 1897, they contained competent illustrations and were obviously very practical and very useful. They were not lengthy, varying between 25 and 50 printed pages. The last one under his authorship was published in 1912. In 1913 he was succeeded by his son, T. H. Schoyen, who continued the work in economic entomology and plant pathology until 1920, when a State Mycologist was established and Schoyen continued as State Entomologist.

His reports continued to be issued annually until 1920, and since that time have been issued every two years.

As with nearly all publications, the new processes of illustration have decreased the cost and therefore increased the number of illustrations, and the reports appear to be full and sound and to contain many important articles.

A special report on insects injurious to forests was published each year from 1915 until 1922, and the present plan is to publish a collective report on this subject each fifth year. Since 1904, W. M. Schoyen and T. H. Schoyen have given lectures in economic entomology in the Agricultural College at Aas, and since 1924 the younger Schoyen has lectured on plant pathology in the winter Agricultural College in Oslo.

Both of the Schoyens have written a number of shorter papers dealing with practical entomology, published in various scientific and popular journals, and the father wrote a manual on zoology for the agricultural colleges which has been very generally used.

RUSSIA

An active entomological society was organized in St. Petersburg in the old days, whose publications date back to 1861. This society is still in existence. Since that date and earlier there have been many good entomologists in Russia, and the collections that accumulated in the great museum in the old St. Petersburg were very large and very fine. There were also large collections in Moscow and at other places.

Economic entomology, however, had no official standing until much later. In 1881-83 three volumes on injurious insects by Theodore Köppen were published. They were rather sparsely illustrated, but were apparently works of value. They were published entirely in the Russian language, and therefore have not become well known to the rest of the world. I have seen them referred to appreciatively in German publications, and Cholodkovsky spoke well of them. The information about Russian economic entomology which I gave in 1894 in my address, "The Rise and Present Condition of Official Economic Entomology" (*Insect Life*, Vol. 7, pp. 55-107), was gathered from correspondence with this same Dr. Nicholas Cholodkovsky. Down to that time there had been no definite official entomologists. Competent scientific men and specialists had been requested to prepare publications on injurious insects, and where these individuals desired pecuniary aid to enable them to publish independent investigations funds were granted by the Government. Köppen's work just mentioned was an instance of this.

The Ministry of Public Lands from time to time had sent out competent specialists to conduct investigations at different points. These

investigations were partly at the expense of the general government and partly at the expense of the authorities of certain sections and at the request of the governors of provinces and scientific and agricultural societies. These reports were published and distributed to all interested. A very considerable amount of work of this kind had been done before 1894, and many important reports had been published. The Russian investigators who had been used in this way were notably Lindeman, Porchinsky, Tarochemsky, Metschnikoff, Cholodkovsky, Schewyröw, and Köppen.

The Ministry of Public Lands also in very important cases called conferences and established temporary commissions. Three Phylloxera commissions and experiment stations were established in this way—one in the Caucasus, another in the Crimea, and a third at Odessa. In addition to these, a corps of so-called "Correspondents on Entomological Questions" was formed by the Ministry; and to these men, who were for the most part members of the Russian Entomological Society living in different parts of the empire, were referred all corresponding farmers and local agricultural societies who were seeking advice as to the best means of fighting injurious insects. Then too, in 1878, the "Odessa Entomological Commission" was founded. A regular entomologist was employed with funds raised by the adjoining provinces.

One of the members of the board of correspondents referred to was Dr. K. Lindeman, whose writings became well known to American and English investigators, since many of his papers were published in the German language.

When I first visited Russia, in 1907, I found that a very good organization for official entomology had been established. Stations were founded in different parts of the country, with official entomologists, all of whom reported directly to Prof. J. Porchinsky of the Ministry of Agriculture whose headquarters were in St. Petersburg. During that year I visited three of these stations—one at Kiev, under the charge of Prof. Waldemar Pospelov; one in Besarabia at Kischineff, under the charge of Prof. Isaak Krassiltschik, and one at Simferopol in the Crimea, under the charge of Prof. Sigismund Mokrzecki. Among the other stations, there was a notable one at Poltava. In addition, there was at St. Petersburg, under Professor Cholodkovsky, a department relating largely to forest zoology. At that time Cholodkovsky was assisted by A. Ssilantjew and P. Spessiwzew.

At Kiev, Pospelov impressed me strongly by his intelligence and efficiency. He readily undertook the task of collecting and studying

the local parasites of the gipsy moth and the brown-tail moth with the help of one of his assistants, and insisted upon the necessity for a careful biological study of each species before attempting to send it to the United States. A small orchard was rented in the suburbs of Kiev, a laborer was engaged, and Pospelov's assistant was employed, all at the expense of the State of Massachusetts, since on that trip I was traveling for the State. All the Kiev expenses, however, were absurdly small, amounting in fact in American money to only \$15 per month.

At Simferopol, I was surprised by the intimate knowledge possessed by Mokrzecki of the latest developments of economic entomology in America. He knew the writings of the principal economic entomologists of this country and admired them greatly. The Crimea was (at least the northern half) a great fruit-growing region at that time. Mokrzecki had introduced the latest American spraying machinery, and one very large orchard at Bakhtchisarai had the appearance of one of the famous, extremely well cared for orchards in the Genesee Valley of New York. He had, almost single-handed, built up an excellent regional museum at Simferopol and gave advice to fruit-growers and farmers on all entomological questions. After the World War he left Russia, taught for a while at Belgrade, and eventually was appointed to a post in Poland which he still holds with distinction. He is chief of the entomological service of the very efficient school and experiment station at Skierniewice.

I may mention incidentally that at the time of this visit to the Crimea there was an admirable Marine Biological Station at Sebastopol. In the library of this institution I saw many American publications, including a number on entomology. Dr. P. S. Galtsoff, now an expert in the United States Bureau of Fisheries, became chief of this station some years after my visit.

Two years later I went to Russia again, going from Berlin to St. Petersburg in early May, principally to visit Professor Porchinsky who had, by correspondence, outlined the previous trip, and who had arranged with Pospelov, Mokrzecki, and Krassiltschik to meet me.

Porchinsky was a very able man and a leader in entomology. He was born in 1848, and was therefore at the time of my visit 61 years old. Since 1875 he had been connected with the Ministry of Agriculture at St. Petersburg. He organized the Bureau of Applied Entomology and became its chief. He dedicated his whole life to entomological work and was intimately connected with the Russian Entomological Society of which he was Secretary for 22 years. He died

in 1916. He was an extensive traveler in Russia and Siberia, studying local pests, not only of agricultural crops but also of domestic animals and of man. His main work was on the biology of insects and especially the biology of Diptera. Certain of his papers dealt with folk-lore and popular superstitions connected with insects. He was a tall, bearded, imposing individual, who spoke French excellently but had no English.

Not long after his connection with the Ministry of Agriculture at St. Petersburg, Porchinsky published, in 1879, in the Russian language, a 70 page pamphlet on the pernicious insects in the South of Russia. The only species referred to by their Latin names are *Cephus pygmaeus*, *Anisoplia austriaca*, and *Dorcadion*.

While in St. Petersburg, I went to the great Imperial Museum and met the workers there. I remember especially Adelung, Kusnezov, Georg Jacobsen, Oshanin, and Mordwilko. The great entomological collections were in the basement of the Museum.

On this trip I visited Moscow, seeing the poorly arranged collections of insects there and finding that there were a number of boxes of unidentified parasitic Hymenoptera that had been collected in the Transcaspian country. The most important feature of this visit to Moscow was a call on Prof. Nikolas Kulagin at the Agricultural College at Petrovsky, about 12 miles from Moscow. At that time Kulagin was a handsome, rather slender man, of medium height, perhaps 45 years of age. He was neatly dressed and had a short, well-cared-for beard. He spoke French readily, and proved to be excellently informed on entomology in general and highly appreciative of the importance of economic entomology. He was the author of very many books and pamphlets. From the standpoint of economic entomology, probably the most important of these works was a large volume entitled "Injurious Insects and the Means of Controlling Them." I have before me the second edition, published in Moscow in 1913. It covers 783 pages, is printed entirely in the Russian language, and contains no illustrations. A separate atlas was promised, but so far as I know was never published. In his preface, the author states that the methods of fighting insects are very far from being thoroughly known, and that in this book he gives the methods that have been suggested and which it is desirable to test on a large scale. The work lacks a bibliographical list, but there are brief references in footnotes, largely to Russian writings.

Some years ago I asked Mr. Jacob Kotinsky (a Russian) to go through this book rather carefully. He found it difficult to do so, owing to the absence of illustrations, bibliographical lists, and adequate

headings and chapter subdivisions, but often met with very interesting information scattered through the pages. The consideration of the group of insects is in systematic order, and the final chapter is entitled "Cultural Methods of Combating Injurious Insects." This is a very significant title and one that I have not seen in general works on economic entomology in other languages. In this chapter occur the following subheads: Entomological Stations; Crop Rotation and Soil Cultivation; Other Cultural Methods; Importance of Birds in Insect Destruction; Fungus and Bacterial Diseases of Insects. In the body of the work there is a discussion of parasites, including an account of the work of Shevirev and Porchinsky and of the later work of Kurdiumov. The large report on the parasites of the gipsy moth, by Howard and Fiske, was also known to him, and is quoted. Roerig, "On the Efficiency of Pest Control by Parasites," is also quoted. I am not familiar with this work of Roerig. Kulagin is still living, I believe (June, 1929), and is still at Petrofsky. Like Pospelov, he has stayed in Russia through the revolution, and is still working, under the Soviet Government. Pospelov visited the United States for the Soviet Government in 1923.

The big book by Kulagin just referred to was anticipated in 1894 by a book by K. L. Bramson, published in the Russian language. Its title, translated, was "Injurious Insects and the Means of Fighting Them (Practical Entomology)". I am unable to give the gist of this book, but its 12 plates were excellent. It was published in two parts, the first part covering 250-odd pages, and the second part 360 pages.

In 1909, N. Kurdiumov, a graduate student of Pospelov's, came to the United States to see how we were handling entomological questions and especially to study with us the matter of natural control, largely in its parasitic Hymenoptera aspect. He was a very brilliant and likeable young man, and visited the various field laboratories of the Bureau, remaining in this country for a number of months and studying all aspects of economic entomology, especially perhaps the matter of natural control. He was especially interested in the gipsy moth laboratory in Massachusetts and in the cotton boll weevil laboratory which at that time was in Dallas, Texas. When he returned to Russia he introduced many American methods, and, from his ability and charming personality, exerted a great influence. He immediately established a modern and up-to-date entomological station and laboratory at the Poltava Agricultural Experiment Station in southern Russia, a place well known to the scientific men of the world on account of its connection with the early work of Metschnikoff. This station immediately attracted attention and was visited by Russian

provincial entomologists who adopted many of Kourdiumov's ideas and introduced his fundamentally American methods in their respective provinces.

One of the most prominent entomologists in Russia in the days before the great war was Prof. Nikolas Cholodkovsky, a man of very high standing and of general culture. He was not only a man of great scientific education, who among other things published many papers relating to economic entomology and especially to forest entomology, but he was a poet and a man of letters. Cholodkovsky was born in 1858; graduated in medicine, and in 1885 was appointed Lecturer in Zoology in the Institute of Forestry. In 1892 he was given the doctor's degree in zoology, and became full Professor of Zoology in the Military Academy of Medicine, filling this place until his death in April, 1921. He published very many entomological papers and also wrote extensively on parasitic worms. He also did extremely fine work upon the Aphididae and the Chermesidae. He published text-books on zoology, comparative anatomy, and pure and applied entomology. He devoted much time to literature, and was known in Russia as the best translator of Goethe's Faust. He also translated poems of Byron, Milton, and Shakespeare into Russian verse. He also wrote many original poems which remained unpublished during his lifetime but were afterwards collected and printed under the title, "From the Herbarium of my Daughter." After the revolution he found his way into Esthonia and appealed to me to find him a place in the United States. I succeeded in enlisting the sympathies of certain wealthy men in this country, and Mr. Charles R. Crane promised to get him a post at the Marine Biological Laboratory at Woods Hole, and to advance the money to bring him over. The funds, unfortunately, reached the United States Consul over there just at the time of Cholodkovsky's death.

To return to Kourdiumov: After his return to Russia he became acquainted with Mamentov, head of one of the divisions of the Russian Department of Agriculture at St. Petersburg, who brought about the financing of the introduction of many American methods into Russian practice. This fortunate contact between a capable administrator and an entomologist of advanced ideas finally led to the establishment, not only of entomological work at the experiment stations, but also of a network of entomological bureaus headed by provincial entomologists.

These bureaus were under the double control and support of provincial or local *Zemstvo* Governments and the central Government at St. Petersburg. This plan of dual control was established in 1912.

In this way entomological bureaus were established at Kaluga, Orel, Voronez, Poltava, Stavropol, Kiev, Tula, Kharkoff, Kursk, Tiflis, and Moscow, while entomological divisions were established at the general experiment stations of Poltava, Shatilov, and Bezenchuk. While the plans of these bureaus and divisions were made by their heads, final approval by local and federal authorities was necessary.

In 1913 an All Russian Congress of Applied Entomology was held at Kiev for the consideration of affairs of organization and cooperative work. With this congress began a decentralization. Professor Porchinsky's influence at St. Petersburg proved insufficient to hold Federal control, and the growth of provincial entomological institutions went forward rapidly. At this period there were among the leaders Adrianoff in Kaluga, Averin in Kharkoff, Borodin in Poltava, and Uvarov in Stavropol. At the same time the stations carried on by Mokrzecki in Simferopol, Plotnikoff in Tashkent, and Krassilstschik in Kischineff, and the divisions in the agricultural experiment stations headed by Kurdiumov in Poltava and Emelianoff in Kharkoff worked ahead in both research and insect control. Doctor Borodin tells me also that a private entomo-phytopathological organization under the auspices of the Sugar Growers Association was established at Smela in the province of Kiev.

Then came the World War and later the civil war in Russia in the course of which two separate governments were overthrown. Naturally this had its effect upon the course of economic entomology. Some of the good men have died and certain others have left the country, but many well-trained and good men remain and have been working with much effect upon different subjects in applied entomology. Kourdiumov, a fine fellow, committed suicide on the Dvina front in the autumn of 1917 when his soldiers deserted. Uvarov went to England and became connected with the Imperial Bureau of Entomology in London where, in the pages of the *Review of Applied Entomology*, he has published abstracts of all of the important papers published in Russia since the war. Borodin came to the United States and became the head of a Bureau of Applied Botany and Entomology, supported by Russian scientific organizations, which was formed largely to secure literature aiding in the development of applied science in Russia. Recently this organization has been expanded to cover all agricultural information, and Prof. J. A. Mirtoff has been placed at the head; Borodin resigning and taking up other work.

Doctor Borodin, by the way, has helped me greatly in this short account of Russian work just before the war and just after the war.

Some admirable workers were carrying on investigations just before the outbreak of the World War. It is most interesting to note that A. F. Radetzky and N. N. Troitsky in Tashkent, Turkestan, started to work in 1913 with the egg-parasites of the genus *Trichogramma* and that Radetzky began to use the species known as *Trichogramma semblidis* Auriv. (considered by Girault to be quite possibly identical with *T. minutum* of the United States) against the codling moth. He showed, in an article published that year, that the species had been known since 1903 in Astrakhan and that J. F. Schreiner had observed that from 65 to 100 per cent of the eggs of the codling moth were destroyed by it. He ascertained the polyphagic habits of the species, and showed that the supply can easily be kept up for use against the codling moth. Pospelov, of Kiev, had taken up this matter; and, in an article published a little earlier, Porchinsky had shown how, by the use of different hosts, the supply of parasites could be maintained. These records are of great interest in considering the much later work of Flanders in California, Hinds in Louisiana, and others, in the breeding of this parasite on almost a commercial scale.

There were noticed in the Review of Applied Entomology for 1913, the year immediately preceding the opening of the World War, a number of Russian publications that seem to have been very well worth while. For example, there are several by I. K. Paczoski published by the Zemstvo of Cherson in the form of popular pamphlets describing the insects injurious to various crops together with a consideration of remedies. N. L. Sacharov published at Astrakhan reports on the insects affecting fruits, market gardening and field crops; while V. Pospelov (previously mentioned) issued several important reports. B. P. Uvarov, since connected for many years with the Imperial Bureau of Entomology in London, was then working at Stavropol, and published reports principally dealing with locusts. D. N. Borodin, working at Poltava, was also doing excellent work. E. V. Jatzenskovich, at St. Petersburg, wrote variously on injurious insects and notably "On the Functions of Entomological Stations."

One of the notable publications of this period was by Porchinsky who wrote in the Yearbook of the Department of Agriculture of the Central Board of Land Administration and Agriculture, St. Petersburg, in 1913, "A Review of the Spread of the Chief Injurious Animals in Russia during 1912." In this article he showed that the Department of Agriculture had published during 1912 six works on

entomology and had republished five books. He gave a list of 23 Russian towns in which bureaus of entomology existed at that time.

An account of Russian economic entomology should by no means omit special mention of the admirable work of T. Shevyrew (1859-1920) whose investigations of the bark-beetles and of the biology of certain parasitic Hymenoptera should be better known to the scientific world and more often quoted. My attention was drawn to the work of this excellent investigator as early as 1908 by J. Kotinsky, but the language difficulty has prevented me from understanding many of his publications.

During 1914 there appeared in the Review of Applied Entomology reviews of many Russian articles, the authors of which seem to have disappeared during the war.

In 1914 Porchinsky published also a long and important report of "The Principal Mites Found in Grain and Flour and Some Information for the Discovery of Injurious Insects in Grain Stores."

One of the most important articles published during this period was by M. N. Rimsky-Korsakov, on the Chalcids of the genus *Isosoma* injurious to grain crops in Russia. It is a pamphlet of 84 pages, with 50 figures, 3 plates, describing several new species and including some attention to the parasites of these joint worms. Practical suggestions as to remedies are included.

In spite of the war, Russian publications continued in large number and reached England so as to be carefully reviewed in the Review of Applied Entomology. A notable article published at Kiev in 1915 by D. N. Borodin describes an outbreak of *Contarinia tritici*, Kirby. This is the insect formerly known as the wheat midge in the United States. It was imported for the first time into Russia in Poltava in 1912, and in 1914 occurred in great numbers.

Among the Russian economic entomologists who died either during the great war or just after it, are the following:

- E. M. Vassiljew, died July, 1919.
- N. V. Kurdiumov, died September 7, 1917.
- V. N. Rodzjanko, died in 1919.
- A. A. Silantjew, died March 21, 1918.
- D. A. Sopotsko, died May 1, 1919.
- J. T. Schreiner, died July, 1918.

And then too, N. A. Cholodkovsky, who died in April, 1921; V. T. Oshanin, who died in January, 1917, and D. A. Smirnow who died August 17, 1920, might also be ranked as economic workers since many of their papers touched on economic entomology. I gain these dates from an article by Walther Horn in *Entomologische Mitteilungen* for September, 1921.

The first annual meeting of the Russian Society of Workers in Applied Entomology was held in Kiev on the 3rd and 9th of November, 1916. It was attended by representatives of the great majority of Russian entomological organizations. The meeting decided to advocate the organization of a central entomological bureau. An interesting paper by I. V. Emelianov was read which discussed the existing entomological organizations. He stated that there were 220 in the whole world, 74 being in Great Britain and its colonies, 68 in the United States, 51 in Russia, Germany having only 7, while China, Turkey, Portugal, and Brazil had none.

At present it appears that the Government of the Union of Socialist Soviet Republics has brought about a good organization and that the entomological side of their phytopathological service is being well handled. The Bureau of Entomology of the Scientific Committee of Agriculture, founded in 1894 and carried on under the directorship of Porchinsky, continued under his leadership until 1916, when he died. He was succeeded by Pospelov, who was followed by N. N. Sokolov for 1917-1918. Pospelov again became chief in 1919 and still holds that office. The organization is now a Division for Applied Entomology of the State Institution for Experimental Agriculture. Its work is subdivided, with Pospelov in charge of the biological section, I. N. Filipjev in charge of the zoogeographic and ecological section, N. F. Meyer in charge of the section of biological control, and A. I. Dobrodejev in charge of the section of forest insects. Then there is an experiment station at Detskoje Selo near Leningrad in charge of N. N. Troitsky, and also a section of taxonomy in charge of J. I. Baeckmann.

There are also other organizations and a number of excellent workers on different aspects of the entomological complex, including such well known men as Rimsky-Korsakov, Bogdanov-Katjkov, Mordvilko, Stackelberg, and Boldyrev. These later facts have been gathered from a paper published by Rimsky-Korsakov and W. Grossmann in the *Entomologischen Anzeiger*, Volume 4, No. 9, October, 1924.

My impression is that Russian work in applied entomology is very apt to be sound, as indeed it is in most branches of science. That nation has produced great men in various lines of scientific work. The agricultural conditions over a vast range of Russian territory are more like those that exist in certain parts of the United States than they are like those of other European countries. Therefore it seems a pity that American workers as well as those in the larger British dominions are prevented by language from at once appreciating the

results reached by the Russian investigators. So long as Uvarov is doing his admirable abstracting work for the Imperial Bureau in London, this does not matter so much, but he will have to be replaced some day. There is no doubt that the large and well illustrated bulletins of the permanent Entomo-phytopathologic Congress of Russia contain a great deal of up-to-date information. Six of these large bulletins were published in 1926 and six in 1927. Evidently much advanced work is being reported in these publications, judging by the illustrations. It is a pity that summaries in English, French, or German are not printed at the end of each number. I can imagine the mental attitude of the authorities on this matter must be, "We have to learn their languages to understand their reports—they should do the same with ours."

This language difficulty is really a serious one, and there must surely be some way in which the results gained in Russia can be made intelligible to the other countries. After Uvarov's availability for this valuable work is lost, possibly the Imperial Bureau will be able to supply his place. At this time of writing, intelligent scientific Russians are to be found all over the world, and it is not so difficult as it once was to find a translator.

The Fourth International Congress of Entomology held at Ithaca, New York, in August, 1928, brought from Russia a very strong delegation. While there were few of them who had much English, nearly all of them spoke either French or German, so it was possible for the American entomologists to talk with them and to learn something of their work and aims. I saw especially Paul I. Adrianov of the Department of Agriculture at Moscow, I. A. Parfentiev of the University of Moscow, N. F. Rimsky-Korsakov of the University of Leningrad, N. N. Bogdanov-Katjkov of the Institute for Applied Zoology and Phytopathology in Leningrad, I. N. Filipjev of the Institute of Experimental Agronomy, Bureau of Applied Entomology, Leningrad, A. B. Martynov of the Academy of Sciences, Leningrad, and V. V. Nikolsky who had previously spent a year in the United States as a Fellow of the International Education Board and who is going to do work in economic entomology in Turkestan. A number of these delegates visited Washington, and Parfentiev and Nikolsky stayed on for some weeks doing bibliographical work in the library of the Bureau of Entomology. The men were all capable and very much in earnest. There seems no doubt that a great amount of sound work is coming from Russia and that many ideas of a practical nature will be evolved there. There is an extent of territory and a variety of climates involved quite comparable to those features of the United

States, and consequently the necessities for successful work in economic entomology will, with the extension of agriculture into regions now largely pastoral or entirely disused, become quite as great as in this country. There is, then, every reason why the results achieved in that country should be known to the people of this and other parts of the world. The language obstacle must in some way be overcome.

An admirable example is the case of the big 943-page work entitled "Guide to Insects" prepared under the supervision of I. N. Filipjev, published the present year (1928), which lies before me. It is obviously a very comprehensive work, illustrated by good line figures, and apparently covers the field of Russian insects, especially so far as the injurious forms are concerned. It includes, in those groups containing many noxious forms, full tables of families, and then full tables of genera under the different families, and again synoptic tables of the principal Russian species under each genus. It appears to be a very useful and instructive work, but I can read none of it except the Latin names. There must be hidden from me by the language many things I wish to know and ought to know.

At the International Congress just mentioned A. P. Adrianov read an important paper entitled "Present Status of Methods and Policy of Controlling Insects Injurious to Agriculture and Forestry in the United Socialist Soviet Republics." This paper was presented in English, and will doubtless be published in the Proceedings of the Congress. Mr. Adrianov touches very slightly upon the history of applied entomology in Russia dating the former Central Experiment Station from 1894 and the first local institution (that at Kiev) from 1904. In the next 12-year period 22 entomological institutions were established, but these 23 local laboratories covered the territory of the then Russian Empire very unevenly. There were no such institutions in the Far East, in Siberia, in the Ural region, the Kirghiz region, the Volga region (except Astrakhan), nor in any of the northern regions of European Russia. Since the war, however, there has been a rapid growth of entomological institutions, and additional ones in all of the regions of the Republic have been established. Mr. Adrianov describes the stations and organization in the different Republics of the Union, and shows that the entomological staff in the various institutions varies from five to twelve (in the majority of the local institutions the average being from five to six).

After the war much damage was done in different parts of the Union by migratory locusts, and these insects have been fought by the poisoned bait method and by the airplane method. Grain insects,

forage insects, and truck crop insects have received special attention, and those of the vineyard have also been studied.

Before the war most of the insecticides and the apparatus for distributing them were imported. At the present time the Republic furnishes its own material as well as knapsack and hand sprayers. A thorough research in the chemical warfare against insects is being conducted.

Government appropriations for the support of this work have been increasing, and for the whole of plant protection during the present year they reached the sum of \$2,500,000. Forest protection so far has been undertaken only spasmodically and on a small scale.

Russia has always bred scientific men and women of very high rank. Her entomologists have naturally been of the highest type. Every entomologist knows Porchinsky, Cholodkovsky, Semenov Tian-Shansky, Mordwilko, Kusnesoff, Nasunov, and Rimsky-Korsakov. Their scientific publications have been of the highest character. Much is to be expected from their followers.

Addenda.—Nearly a year after this account was written, Mokrzecki published in the *Anzeiger für Schädlingkunde* an account of K. E. Lindeman who died February 1, 1929. I had supposed that Lindeman was long since dead, since I had not heard from him for many years and since the photograph he sent me in the 1890's was apparently that of a man well past his 50th year. Mokrzecki's very interesting and appreciative account of Lindeman's life and work indicates that he deserves additional consideration in an account of Russian economic entomology. Briefly, he was born in 1844. His father was a physician, and he himself began the study of medicine. He graduated at Dorpat and became a teacher in the Agricultural High School at Molodetschno, later becoming professor in the well known Agricultural College at Petrowski. He published an outstanding monograph of the wood-boring beetles of Russia, and successively held several other positions. His work in the field of applied entomology was of great value, and it is stated that most of the important injurious insects in Russia were either described by him or considered in some one or another of his list of 200 publications. Mokrzecki states that he was a shrewd observer, a prominent speaker, and a skilled orator. In 1892 he opposed the movement to establish an Imperial Bureau of Entomology and insisted upon the continuance of various institutions for plant protection in different parts of the Empire. He early advocated the introduction of resistant vines against the Phylloxera, as opposed to the radical control method that was at first generally advocated. His correspondence with Washington in the late 1880's

and early 1890's principally concerned the Hessian fly and its parasites, several species of which he described.

After reading this all over I find that I have not said enough about the important work of Professor Bogdanov-Katjkov. He is a comparatively young man, a graduate of the University of Leningrad and as early as 1918 founded a Plant Protection Station for the northern part of European Russia. In 1924 the journal entitled "Plant Protection" was started and is now in its seventh volume. More than 300 men have been educated at the station in entomology and plant pathology at the Institute of Applied Zoology and Plant Pathology at the Agricultural Institute of Leningrad. Professor Bogdanov-Katjkov's main specialty in taxonomy is the family Tenebrionidae, and in applied entomology kitchen garden and truck pests. He has published about 100 papers. His work on Palearctic insects injurious to kitchen garden crops will shortly be published. It will contain 1500 or more figures.

LATVIA

The new Republic of Latvia was formed after the World War, out of the former Russian province of Courland with some adjacent territory. I am greatly indebted to Mr. E. Ozols, of Riga, for much of the following.

Injurious insects attracted attention in the province many years ago, and in 1822 cereal crops were severely attacked by the frit fly. In 1910 the Central Agricultural Society began to agitate organization; and in 1913, in connection with the Department of Agriculture, founded the Baltic Bio-entomological Station at Priekuli which extended its functions over the whole territory now occupied by Latvia and Esthonia. J. Bickis was the head of the Station, and its work included both economic entomology and applied mycology.

After the great war the work was divided between two entomologists, W. N. Rodzjanko and K. Zolk, the latter at the present time being in charge of the Station of Experimental Entomology of the University of Esthonia. Immediately after the war, E. Ozols, and soon after, J. Zirnits joined the Station.

In 1924 the Station was reorganized as an Institute for Plant Protection consisting of three departments, namely Entomology, Mycology, and Botany. The Station now has a central office, laboratory, and museum at Riga, a permanent field branch at Priekuli superintended by J. Zirnits, and a seasonal laboratory of forest entomology at Cirava. In 1929, E. Ozols was made Director of the Institute, and

during very recent years different lines of entomology were investigated by L. Bramanis, O. Conde, and O. John. These men have done very good work, making faunistic and biological studies upon a number of groups of insects and also upon all of the important insect pests.

Information on the control of injurious insects is put out to the public by demonstrations, lectures, and publication of pamphlets on the more important pests (35 of these have been issued). Also the radio is used for quick communication widely among the population; and the daily press is also called upon for propaganda work. The gardeners and the minor farmers readily adopt the suggestions of the Station.

The Institute is incorporated with the Central Agricultural Society and extends its function to the whole country. It is subsidized both by the Society and by the State.

There has been legislation with regard to trade with live plants and their parts and also in the control of potatoes.

The chair of applied entomology in the agricultural faculty of the University of Latvia is held by L. Gailits, who is Government Entomologist to the Department of Forestry of the Ministry of Agriculture.

The principal insect pests are largely those of surrounding countries. It is interesting to note that in 1929, after an interval of 36 years, there was a serious outbreak of the Hessian fly which caused an approximate loss of a million dollars.

In 1929 Doctor Ozols published a long article on an outbreak of *Galerucella tenella* on strawberry.

CZECHOSLOVAKIA

Of the different countries comprising the old political organization known as Austria-Hungary, the people of Bohemia, now included in Czechoslovakia, were among the first to realize the importance of economic entomology. I knew of the reports written between 1850 and 1870 by Dr. Franz A. Nickerl, a member of the Patriotic-Economic Society of the Kingdom of Bohemia, an organization which fostered the affairs of agricultural and general social economy; and I also knew the work of his son, Dr. Ottokar Nickerl, who took up the work after his father's death in 1871 and published a series of short articles on injurious insects. This son later became Principal of the Seed Control Station of the Agricultural Council for the Kingdom of Bohemia, and published an annual report on the principal insects

injurious to agriculture during the year. These reports, 13 in all and published between 1875 and 1890, were issued partly in the reports of the State Agricultural Council, partly by the Society for Physiokratie, and partly privately by the author. One hundred and eight species are included in these reports, and of these, 18 occur in the United States as introductions from Europe.

My friend, Dr. S. Soudek, of the Agricultural College at Brno, informs me that the real father of work in economic entomology in Bohemia, however, was Dr. Karel Slavoj Amerling, a physician, philosopher, and scientist, who started the Physiokratic Society in Prague. Amerling published, among many other things, several papers on economic entomology, with illustrations. He also studied insects and their host plants in mutual relation in what he called a "nature complex"—really what is now (following Moebius) biocoenosis. Most of Amerling's publications concern scale insects and mites. The elder Nickerl was a collaborator of Amerling; and the young one, as we have just seen, followed him.

Doctor Soudek places the founding of the Bohemian Entomological Society in Prague in 1904 as the next most important step in the development of entomology, including economic entomology, in the Czech parts of the old Austro-Hungarian Empire. This he has told me was due to Frant. Klapalek, a well known specialist in the insects of the Pseudoneuropteroid series. The principal name among the very few economic entomologists of that time was that of Dr. J. Uzel, whose very sound studies of the Thysanoptera became well known. Uzel was the head of the Entomological Section of the Research Institute of the Sugar Industry.

There were no special institutions devoted to economic entomology or plant pathology in what is now Czechoslovakia until after the revolution of 1918. Then the Czechoslovakian Government organized four phytopathological research institutions (phytopathology here in the very objectionable European manner, covering economic entomology as well). These institutions were placed in Prague, Brno, Bratislava, and Kosice, and a research institution for forest protection was established in Prague.

All of these institutions have done good work, with control predominantly in view. It is possible that they have suffered, however, on the research side on account of the lack of specialists who are able to confine themselves to one particular branch of work. But a great deal of excellent work is being done. Dr. J. Komarek is the Professor of Applied Zoology, and I think Phytopathology, at Charles University at Prague, and has been doing excellent work, mainly on forest

insects. Dr. F. G. Rambousek¹ is the head of the Pest Laboratories of the Sugar Beet Hygiene Organization; and in the Phytopathological Laboratory in the city of Prague four good men are at work, namely E. Baudys, F. Stranek, C. Blattny, and J. Rozsypal. All four have done good work. I remember especially Baudys' report on the insects of Czechoslovakia in 1920.

There is an excellent Department of Entomology in the large museum at Prague, and there men are working on the taxonomy of several groups of economic interest. Dr. J. Obenberger, for example, the Curator of the Entomological Department, works with the Buprestidae of the whole world. Doctor Rambousek, above mentioned, is working on the Staphylinidae of the world. Another excellent coleopterist is Ant. Fleischer. Karl Sulc is working on the Coccidae, and J. Zavrel is doing admirable work on the biology of the small Diptera of the families Culicidae and Chironomidae.

Eight volumes have appeared of a periodical published by the phytopathological stations, entitled *Ochranarostlin* (Plant Protection), which contains contributions on economic entomology; and reports and bulletins of the agricultural experiment stations also contain contributions from economic entomologists.

I am also informed that many entomological papers are published for the use of schools, farmers, foresters and gardeners, and that many of the scientific workers in Czechoslovakia publish their contributions in foreign periodicals.

In August, 1925, Dr. Stepan Soudek, of the Agricultural College at Brno, came to the United States under the terms of a traveling fellowship of the International Education Board. He remained in this country for a year, spending the college year at Cornell University and later visiting field stations of the Federal Bureau of Entomology and State agricultural experiment stations. Doctor Soudek was at that time a very enthusiastic and very intelligent young man, sobered and aged beyond his actual years by six years' service in the army during and after the World War. He returned to Brno full of enthusiasm for the United States and with a thorough acquaintance with the methods and achievements of the applied entomologists of this country.

In August, 1927, I had the opportunity of visiting Czechoslovakia. Doctor Soudek was commissioned by his Government to meet me in Prague and to accompany me during the period of my stay. We were

¹ In 1928 the Ministry of Agriculture published a large volume by Doctor Rambousek on Agricultural Zoology. It covers 400 pages (of which 250 relate to insects) and carries 271 illustrations.

joined by Doctor Komarek and Doctor Rambousek, and together we visited many places of interest, meeting Doctor Obenberger and his assistants at the Museum in Prague. Among them, I was very glad to make the acquaintance of Ogloblin whose work with some of the parasitic Hymenoptera had attracted my attention. We also met Stranek and Blattny at the Phytopathological Station in Prague. One of the most interesting experiences was a 200-kilometer trip across Bohemia, Moravia, and Silesia, east to Troppau, for the purpose of examining the forests which had been dusted by means of army airplanes early in the season under Komarek's supervision. The observations were made largely on the estate of Prince Lichnowski. A practically continuous red spruce forest 70 years old, in a hilly country, was owned partly by the Government, partly by Prince Lichnowski, and partly by the city of Troppau. The town would not contribute any financial aid, and its trees were not dusted. The result was that in August, at the time of our visit, the dusted area showed new growth at the tops of the defoliated trees, while on the areas owned by the city the attempts of the trees to recuperate were at once ruined by caterpillars that had not been killed by airplane operations. Some trees had died on the treated areas and had been felled and cut and piled for the paper mills, but the city forest over large areas was obviously past help. Even those that were disposed of brought but a small fraction of their potential value.

Later (in September) I met Komarek, Rambousek, and Soudek at the International Congress of Zoology in Budapest, where Komarek gave a public address on the forest work just described, and in 1928 Rambousek came to the United States for a brief visit at the time of the International Congress of Entomology at Ithaca, New York, in August of that year.

It seems to me that much may be expected from Czechoslovakia. Its present Government is at the same time conservative and enterprising. Its Academy of Agriculture is a vigorous institution, and the building it has erected in the city of Prague is a model of its kind. All of the latest ideas in regard to interior architecture have been adopted, and many novel features, especially in the way of lighting, have been introduced. I appreciate very highly my election, in 1926, to honorary membership in this distinguished Academy.

Doctor Soudek's book, entitled (translated) "Practical Entomology in the United States of America," was published early in 1930 by the Czechoslovak Academy of Agriculture. It is a royal octavo book of

about 150 pages, illustrated by 35 half-tones. It has the appearance of being competent and complimentary; but, unfortunately, I cannot read it.

POLAND

A number of good workers in entomology have been of Polish origin, for the most part resident, however, in other countries. We can treat of Poland as a separate entity practically only since the World War, although as a matter of fact the development of economic entomology in that country began as early as 1904 with the founding by the Horticultural Society of Warsaw of a station for plant protection. However, it was not until 1912 that this station was able to get means and support from the Government and from agricultural circles so that real work could be begun. Little entomology was considered at this station, which devoted itself to plant diseases. An agricultural station was established in Cracow, and this station also was given a department of plant protection. The outbreak of the World War, however, in 1914, stopped work in both places.

At the conclusion of the war the present Polish Government was established, with its Ministry of Agriculture among others, and under this Ministry a Scientific Institute of Agriculture was established in Pulawy. Under this Institute there were several departments, and phytopathology and economic entomology were given independent rank, and field experiments were begun.

Since 1918, research and educational work in connection with agriculture has been much expanded. Plant protection stations connected with the Institute at Pulawy were established in Bydgoszcz for western Poland, and in Lwow for the southern districts. Entomological and phytopathological laboratories were also established at the universities and at special schools. Among these should be especially noted the Entomological Institute of the Mean School of Agriculture in Skierniewice (near Warsaw), in the Institute of Agricultural Zoology at the University in Poznan, in the Zoological and Botanical Institute at the University in Wilno (northeastern district). At the latter place work has been begun which will result in a special station adapted to the conditions of cereal and fruit growing in that part of Poland. Moreover, the Zoological Laboratory of the Free University of Poland in Warsaw is used for some parasitic work in plant protection, chiefly in forestry.

Following great damage to grain crops in 1925 to 1927 by the Hessian fly, the frit fly and its relatives, private societies such as cham-

bers of agriculture, associations for the production of beet sugar, and so on, became interested in economic entomology and have cooperated with the State in the organization and support of control work. Thus quite recently stations have been established in Poznan, in Torun, and in Sarny. In the same way a special station for the study of measures of protection of hops has been established in Luck, and for sugar beets in Warsaw. There are now, therefore, 12 stations for plant protection in Poland. In addition, the different agricultural experiment stations scattered through the country include more or less work on entomology. There are 27 such stations, and many of these have recently added young entomologists or phytopathologists to their staffs, largely for educational work.

It is noted that there is a strong tendency to specialize in economic entomology among the younger generation of workers. An Association of Economic Entomologists (including several phytopathologists) has been founded, and at the time of my last information (June, 1929) had a membership of 50. There has been formed an organization known as "The Union of Agricultural Experimental Institutes of the Polish Republic." This Union is of an administrative character and has a Section of Plant Protection which acts in a way to coördinate the work of the different stations and research organizations. It has begun this work by the publication of a series of bulletins, of which one, entitled "Plant Diseases," has been issued.

I was greatly interested in a visit I made to Poland in August, 1927. I was received with great courtesy by the officials of the Ministry of Agriculture, and took several automobile trips to different parts of the country. I visited the important stations at Skierniewice and Pulawy and met a number of the excellent workers. The chief entomologist at Skierniewice at that time (and he still holds the post January, 1930) was my old and distinguished friend Zygmunt Mokrzecki whom I had met in 1907 in the Crimea. After the revolution in Russia Professor Mokrzecki escaped to Constantinople and soon after became connected with important work in Belgrade, later going to Poland where he was given the post at Skierniewice. He has established there a very competent service with several good assistants, among them K. Strawinski who has published some very good papers. At the time of my visit S. Nowicki was working with him, but has since been transferred to another station.

At Pulawy, S. Minkiewicz is in charge. Doctor Minkiewicz came to the United States as a Rockefeller student in the early part of 1927, and remained in this country for many months. He was in America when I visited Poland. He traveled extensively in the

United States and Canada and visited many experimental stations. He is a man of much ability, and much is to be expected from him in the way of research and organization. Before starting for America he had made an important study of the bionomics of *Psylla mali* and had done other excellent work.

Prof. R. Bledowski, connected with the Free University of Poland as Professor of Zoology and Comparative Anatomy, is an entomologist much interested in the economic aspects of the science. I had the pleasure of meeting him at the Third International Congress of Entomology at Zurich in 1925. He met me when I arrived in Warsaw in 1927 and accompanied me on my different trips, and I am greatly indebted to him for very many courtesies, in fact most of the information in this section about Poland has been given me by him. He has made numerous entomological investigations, some of them of distinctly economic bearing.

Other men who have worked with economic entomology in Poland are J. Trüffer at Wilno, L. Sitowski at Poznan, A. Krasucki at Lwów, J. Ruskowski at Warsaw, K. Zimm at Cieszyn, S. Keler at Bydgoszcz, and J. Niezabytowski at Cracow. Since my visit excellent papers have been published by Sitowski, Niezabytowski, Ruskowski and Strawinski.

While in Poland I was greatly interested to see two demonstrations of fumigation work in orchards and forest by means of large arsenic candles invented by Lieutenant Colonel Woynich-Sianozecki. The demonstrations were extremely interesting. The fumes from the candles spread enormously, leaving an arsenical deposit on the leaves, and I was assured that the treatment was very efficient against leaf-feeding insects. I was greatly impressed and have since endeavored to have similar experimentation carried on in this country.

Note Added June 6, 1930.—Just as I am about to send this manuscript to the editor, I have received from my distinguished friend Prof. Z. Mokrzecki an explicit statement of the present Polish organization, and I add it in his own words.

THE PRESENT STATE OF PLANT PROTECTION IN POLAND

When, after a 150-year period of slavery, Poland became an independent state and united its several countries into one whole, energetic action in all directions of scientific life began, in spite of the grave influence of the ruinous World War and the economic weakness of the country. A great deal has been done. In order to give an easy orientation of the existing plant protection stations in Poland, I have classified them into the following divisions:

I—The network of plant protection stations under the Ministry of Agriculture.

II—Private and communal institutions occupying themselves with plant protection.

III—Universities and equivalent schools whose entomological laboratories are working with theoretical problems and take part in the action of combating pests that occur epidemically.

I—STATE NETWORK OF THE PLANT PROTECTION STATIONS
(MINISTRY OF AGRICULTURE)

- 1—Plant Disease Division, State Institute of Agricultural Science in Bydgoszcz (Bromberg), which has as its aim the investigation of pests and is besides a central institution of the state plant protection stations. Director: Prof. Dr. L. Garbowski; Dr. St. Keler (entomologist).
- 2—Plant Protection Division of the above Institute in Puławy, acting for territory of the province (województwo) of Lublin. Directors: Dr. S. Minkiewicz (entomologist) and Prof. Dr. W. Siemaszko (mycologist).
- 3—Plant Protection Section of the Agrobotanical Station in Lwów (Lemberg) under the above Institute. It acts for the provinces of Lwów, Stanisławów, and Tarnopol. Director: Dr. A. Krasucki (entomologist).
- 4—Plant Protection Station of the Warsawian Horticultural Society in Warsaw, working for the provinces of Warsaw, Łódź, and Białystok. Director of the Station, Prof. Dr. W. Gorjaczkowski (phytopathologist); leading the Entomological Section, Dr. J. Ruszkowski.
- 5—Plant Protection Station of the Pomerellian Chamber of Agriculture in Toruń for the provinces of Pomorze (Pomerellia). Director of the Station, Eng. S. Nowicki (entomologist).
- 6—Plant Protection Section and the Section of Control of the Wart Disease of potatoes, Experimental Station, Agricultural Chamber of Great-Poland in Poznań. Director of the former, Eng. A. Kuryllo; Director of the latter and the Experimental Station, Dr. K. Celichowski. Territory of action: province of Poznań (Great Poland).
- 7—Plant Protection Station of the Agricultural Society of Little Poland in Krakow (Cracow) acting for the provinces of Krakow and Kielce. Director, Prof. Dr. K. Rouppert (phytopathologist).
- 8—Silesian Plant Protection Station in Cieszyn (Teschen), acting for both Silesias (Upper and Cieszynian). Directors: Dr. A. Piekarski (phytopathologist) and Dr. K. Simm (entomologist).
- 9—Plant Protection Station of the Agricultural Society in Wilno, for the provinces of Wilno and Nowogrodek. Directors: Prof. J. Trzebinski (phytopathologist) and Dr. J. Prüfer (entomologist).
- 10—Plant Protection Section of the Experimental Institute for Peat Culture in Sarny for the province of Polesie. Director, Miss M. Boczkowska.
- 11—Plant Protection Station of the Volhynian Agricultural Society in Luck (Luck) for the province of Volhynia. Director, Eng. M. Dabrowski (phytopathologist).

THE WORK OF THESE PLANT PROTECTION STATIONS

- (1) Fulfilling the tasks with which the Ministry of Agriculture has charged the Stations in its orders in the control of plant pests, diseases and weeds.

- (2) Organizing of a general survey in the respective regions and registration of the pests.
- (3) Communicating to the administrative authorities and the State Institute of Agricultural Science reports, accounts, and opinions.
- (4) Educating the region to appreciate the importance of plant protection.
- (5) Observations on and investigation of the plant diseases, pests, and weeds having greatest economical value in the district.
- (6) To give sanitary certificates of plants and plant products used in trade according to the power given by the Ministry of Agriculture.

II—PRIVATE AND COMMUNAL INSTITUTIONS

- 1—Station for the protection of the sugar-beet plantations of the Institute of Sugar Industry in Warsaw. Director: A. Chrzanowski (entomologist).
- 2—Division of Insecticides and Fungicides produced by the chemical industry in Poland, in Zgierz near Lodz. Director of the division: Eng. M. Nowinski (chemist).
- 3—Military Gas Institute in Warsaw. Experiments upon insecticides and fungicides and toxicological experiments. Director: Prof. Eng. Z. Woynich-Sianozecki. Director of the Division of Toxicology: Prof. Dr. W. Lindeman (toxicologist).
- 4—Plant Protection Station of the Horticultural School in Poznań. Director of the Station: Dr. K. Zaleski (phytopatologist).

III—LABORATORIES OF THE UNIVERSITIES AND EQUIVALENT SCHOOLS DEVOTING THEMSELVES TO PLANT PROTECTION

- 1—Institute of Forest Protection and Entomology of the Principal School of Agriculture in Skierniewice. Besides the pure scientific and teaching work, devotes a great deal of time to the matter of organization and to the control of pests occurring epidemically. Investigations in the sphere of applied entomology. Director of the Institute: Prof. Z. Mokrzecki (entomologist). Assistants: Dr. K. Strawiński (entomologist) and Eng. J. Obarski (forest entomology).
- 2—The laboratory of Entomology and Zoology of the Posnanian University. Teaching work and investigation of injurious insects. Director: Prof. Dr. L. Sitowski (entomologist). Assistant: Eng. A. Lincke (zoologist).
- 3—The Laboratory of Forest Protection of the Polytechnicum in Lwów. Teaching work in forest protection and investigation of forest pests. Director of the Institute: Prof. Eng. A. Kozikowski (forest entomologist). Assistant: Dr. R. Kuntze (entomologist).
- 4—Zoological Laboratory of the Free Polish University in Warsaw. Teaching work and theoretical topics of entomology and zoology. Director: Prof. Dr. R. Bledowski (entomology). Assistant: Mrs. M. Krainska (entomologist).
- 5—Zoological Laboratory of the University in Wilno. Teaching work and theoretical investigations of zoology and entomology. Director: Dr. J. Prüfer (entomologist). Assistant: Miss M. Raciecka (zoologist).
- 6—The Botanical Laboratory of the University in Wilno. Teaching work and phytopathological investigations. Director: Prof. Dr. J. Trzebinski (phytopathologist).

- 7—The Phytopathological Laboratory of the Principal School of Agriculture in Warsaw. Teaching work and theoretical problems of phytopathology. Director: Prof. Dr. W. Siemaszko (phytopathologist). Assistant: Miss W. Konopacka.
- 8—Lessons of theoretical Entomology at the Warsawian University, Faculty of Natural and Mathematical Sciences. Director: Prof. Z. Mokrzecki (entomologist). Assistant: Dr. K. Strawinski (entomologist).

ADDED INSTITUTIONS

- 1—Plant Protection Section of the Union of Agricultural Experiment Stations of the Republic of Poland. President: Prof. Dr. Z. Mokrzecki. Secretary: A. Chrzanowski.
- 2—Polish Entomological Union in Lwów. President: Prof. Z. Mokrzecki. Vice-Presidents: Prof. R. Bledowski and Prof. J. Lonnicki. Secretary and Editor: Dr. J. Kinel. The above Union publishes the Polish Entomological Journal (*Polskie Pismo Entomologiczne*).

Investigations upon human parasites as well as their control and the vectors of diseases: Division of Parasitology of the Hygienical Institute in Warsaw. Director: L. Anigstein, M.D. Technical consultant: Prof. Z. Mokrzecki (entomologist).

The results of the investigations and experiences of the above mentioned laboratories are published in the following Polish periodicals:

- 1—*Polski Pismo Entomologiczne* (Polish Entomological Journal). Lwów ul. Rutowskiego 18. Editor, Dr. J. Kinel.
- 2—*Choroby i Szkodniki Roślin*. Warsaw ul. Bagatela 3. Editor, Prof. Dr. W. Gorzaczkowski (appeared till 1927).
- 3—*Roczniki Nauk Rolniczych i Leśnych* (The Annals of Agriculture and Forestry). Poznań. Ul. Mazowiecka 26. Editor, Prof. Schramm.
- 4—*Las Polski* (Polish Forest), Warsaw. Nowy Świat. 36. Editor, Prof. Szwarec.
- 5—*Doświadczalnictwo Rolnicze* (Experimental Work). Warsaw Kopernika 30. Editor, Prof. S. Miklaszewski.
- 6—*Sylvan*. Lwów.
- 7—*Gazeta Rolnicza* (Agricultural Gazette). Warsaw.

JUGOSLAVIA

In this country applied entomology has come to the front only within the past few years. The Minister of Agriculture at this time of writing, Dr. Otto Frances, took office January 6, 1929, and is making every effort to build up agriculture on a very broad scale. There are in Jugoslavia several institutions at which entomological work is being done. At the University in Belgrade, Dr. J. Wagner and Docent Dr. M. Gradojavie act as entomologists. At Zagreb, Dr. A. Langhoffer, emeritus professor at the University, acts as entomologist. There are several stations employing entomologists, and at the

Hygienic Institute at Zagreb Dr. N. Baranov, in charge of the Division of Parasites, also works on injurious insects. The subject of medical entomology is handled by several experts. Articles on entomology are contained in the reports of the Ministers of Agriculture and of Public Health, and there are two periodicals that contain entomological matter, namely *Gospodarska Smotra* (Agricultural News) and *Gospodarski List* (Agricultural Gazette).

The Hygienic Institute at Belgrade is wonderfully well equipped and is a thoroughly up-to-date institution. I visited it briefly in 1927 and was greatly impressed by the buildings and by the working force. Dr. Eugen Dzunkovski is in charge of the Division of Parasites of this institution, and there are two entomologists, namely Madame Anna Bragina and Dr. P. Vukasovic, who are working on insects of economic importance. Madame Bragina was formerly an assistant of Doctor Mokrzecki, and is trained in a variety of entomological work. At the time of my visit she was investigating some insects affecting tobacco fields, but fortunately returned to the city in time for me to see her. In 1926, Madame Bragina studied the parasites of the codling moth and of certain other insects. Doctor Vukasovic in 1928 published on the subject of an outbreak of *Lecanium corni*. The same insect seems to have appeared injuriously in all of the Balkan countries about that time. He also published in that year an excellent article entitled "A Contribution to the Study of Entomophagous Insect Parasites." This Serbian entomologist studied in Paris and published in French many papers relating principally to the host relations of parasitic Hymenoptera. His name in the French and English publications is spelled *Voukassovitch*.

Doctor Langhoffer, whom I had the pleasure of meeting at the Zoological Congress in Budapest in 1927 and who is a most intelligent veteran, informs me that among the other workers on economic entomology at present in Yugoslavia are Prof. Dr. Operman and B. Hergula at Zagreb, Prof. Dr. Z. Kosacevic at Osijek, Doctor Turina at Krizevei, Engineer Popovic at Sarajevo, P. Novak at Split, Doctor Trausmueller in Susak, Doctor Sfaric in Trogir, and Doctor Simic in Skolje.¹

Doctor Langhoffer informed me, under date of July 10, 1929, that the Ministry of Agriculture was spending large sums on the control of *Lecanium* on plums and prunes, and also large sums on silk culture.

¹ In 1926 I noted an article on the elm leaf beetle by R. Sarnavaka, published at Zagreb.

RUMANIA

There has long been a Museum of Natural History in Bucharest; and for many years a first-class entomologist and long-time correspondent of the entomologists in Washington was A. L. Montandon who specialized in the Heteroptera and whose work was well known to the entomologists of the world. Montandon, by the way, published a paper, as early as 1901, on the injurious insects of Rumania.

Since the World War Rumania has grown in size and importance among the nations, and has realized the importance of plant protection. In 1926 an article was published in the *Anzeiger für Schädlingkunde* by Dr. W. Knechtel entitled "Applied Entomology in Rumania." In this article it was shown that the Department of Agriculture had a Bureau of Plant Protection in which there were two officials. The country was divided into two sections, each of which was visited by one official, and all experimental farms, vineyards, and nurseries of the Government were inspected every two months. Diseases and infestations by injurious insects were reported at headquarters and necessary steps were taken to effect control. The Bureau published charts and bulletins and gave information and advice. Doctor Knechtel's comment was to the effect that the Bureau was not well established by law and not based upon scientific principles and was not organized for research. He showed, however, that there were certain scientific institutions in Rumania having charge of investigations of infestations by injurious insects. The oldest and most important was the Section of Agricultural Entomology of the University of Jassy, which was in charge of Prof. Dr. J. Borcea who was also Director of the Laboratory of Systematic Zoology. He further pointed out that there was in Bessarabia a bio-entomological station at Kichineff, founded by the Russians. I visited this station in the old days in 1907 when it was in charge of Isaac Krassiltschik. At the time of my visit, Krassiltschik was in Berlin, a misunderstanding of dates, owing to the Russian calendar, preventing our meeting. But later he was of much assistance to Prof. Trevor Kincaid when he worked in Bessarabia on the parasites of the gipsy moth. Doctor Knechtel adds further that the Laboratory for Systematic Zoology of the University of Bucharest, in charge of Prof. Dr. Popovici-Băznosănu, had recently established a division for the control of injurious insects. Further, the German settlements in Bessarabia were stated to have recently established a station at Tarutino for the control of insect infestations under the directorship of Dr. Karl Stumpf. Lectures on agricultural entomology were given at the Agricultural High School at Cluj and Herestrau, and also at

the Agricultural Institute of the University of Jassy. Entomology was taught as a side line of natural history in the agricultural schools.

Dr. R. Jeannel, of Paris, who lived in Rumania for a time and who often visits that country, wrote me from Cluj on January 19, 1930, and informed me that in 1928 an Institute of Agricultural Research was founded in Rumania and that this Institute comprised numerous sections. He further showed that there are five institutions, dependent on the Ministry of Agriculture, in which there exist either instruction in entomology or laboratories for research in applied entomology. These institutions are the Superior School of Agriculture at Bucharest, the Academy of Agriculture at Cluj, the National School of Viticulture and Horticulture at Chisinau, the School of Horticulture at Bucharest, and the Institute of Agronomical Research of Rumania at Bucharest. In this latter institute there is a Section of Entomology with a Director, an assistant and a preparator. The Director of this important section is Dr. W. Knechtel, the author of the paper just referred to, and the representative of Rumania at the International Congress of Entomology at Ithaca, New York, in August, 1928.

Long before this organization, occasional papers had been published by the Section of Science of the Rumanian Academy and elsewhere. Prof. G. N. Fintescu of Jassy was the author of a number of these papers. He published, for example, in 1914, a contribution to the study of *Hyponomicuta malinella*, and later showed that the Hemipteron *Capsus mali* Myer is an enemy of the larva of *Hyponomeuta*. Still later he published on one of the rose sawflies.

I am indebted to the very well known zoologist, Prof. J. Borcea, for a very competent report on the insects injurious to agriculture in Rumania and the means employed to combat them. Professor Borcea is not only Professor of Zoology in the University of Jassy but is also Director of the Zoological Station at Constantza. In this report, which should surely be published (I hope that it will be published in Rumania) there is a careful consideration of the geographic and faunistic conditions and an account of the ravages of different important insects including grasshoppers, May beetles, wireworms, and so on, together with some consideration of the insects that affect different crops including a very interesting list of the enemies of cereals, fruit trees, forests, and so on. Professor Borcea in his research work is assisted by collaborators and by two assistants, Messrs. M. Constantineanu and P. Suster. Both of these gentlemen and Professor Borcea himself have published numerous important papers and have paid rather especial attention to the matter of parasites and

natural control. An especially important paper by Borcea relates to the damage caused by Bostrychid beetles in Rumania. Mr. Suster has published a very important work on the Tachinidae of Rumania.

The manuscript report referred to in the opening sentence of the preceding paragraph has been published since that paragraph was written. Today (April 18, 1930) I have received from Professor Borcea Parts 1 and 2 of Volume 16 of the Scientific Annals of the University of Jassy, and this particular paper is published on pages 263 to 276. To this paper is added a list of certain publications that consider the entomological fauna of Rumania and the insects injurious to agriculture. It is not a long list, but it includes mention of several papers of importance. Most of those relating to injurious insects have been written by Professor Borcea and Professor Fintescu. There is also published in the same volume a very interesting report by Professor Borcea and Mr. Suster on the ravages caused in Rumania by the Russian caterpillar (*Loxostege sticticalis*). The article includes a consideration of its natural enemies and the means employed to combat the insect. Mr. Suster's long and fine paper on the Tachnidae is printed in the same volume.

BULGARIA

The pests of cultivated crops in Bulgaria apparently do not differ strikingly in character from those of surrounding countries. The Bulgarian Society of Naturalists in 1914 published in its Memoirs two articles by Iv. Bouresch on the nocturnal Lepidoptera of Bulgaria with especial reference to injurious species, and in 1919 the Journal of the Bulgarian Academy of Sciences published an article by D. Iltschew on *Deilephila norii* and the damage done by it. Later there existed an Institute for Agronomical Research at Sofia which published a Review; and in 1921 in this Review there was an article on one of the sawflies in the plantations of pines by D. Ioakimov. There was a distinct entomological section to this Institute, and reports were published in 1923 and 1924 by Dr. P. Tschorbadjieff (spelled in the Review of Applied Entomology *Chorbadzhiev*). In 1928 an article by Iv. Georgieff on the vine moth in Bulgaria was published, and in 1927 a report on forest insects by M. D. Ruskov was printed in which 63 forest pests were recorded. Other articles on injurious insects have been written by Bouresch and by A. K. Dryenowski.

Doctor Tschorbadjieff published a series of articles on injurious insects of Bulgaria in the years 1924 to 1927, and there was established (the exact date is not known to me) an Entomological Section of the Central Experiment and Control Agricultural Station in Sofia.

In 1928 Doctor Tschorbadjieff attended the Fourth International Congress of Entomology at Ithaca, New York, as the official delegate of the "Station agronomique de l'État à Sofia"; and in 1929 he published what is apparently an article that I should like to be able to read, entitled "Agricultural Entomology in Bulgaria and Pests of Cultivated Plants in that Country." The Review of Applied Entomology for October, 1929, gives two short paragraphs to this publication, and indicates that it gives a report of the work of the Station and a history of the study of injurious insects in Bulgaria. The article was published in the Russian journal entitled "La Défense des Plantes," the bulletin of the Permanent Bureau of the Entomophytopathologic Congresses of Russia, Volume 5, Nos. 5-6, issued at Leningrad and published in the Russian language.

Addendum.—Since the completion of this manuscript and its submittal to the Smithsonian Institution for publication, I have received from Dr. P. Tschorbadjieff a short manuscript which I greatly regret did not reach me at an earlier date. From this manuscript the following facts are drawn.

Economic entomology in Bulgaria dates from 1902 when an agricultural experiment station was founded in Sadowo near Plowdin. In 1905 another experiment station was established near Rustschuck. No especially trained entomologists were employed by these stations and the entomological work was done by agronomists.

In 1911 an entomological division was organized with the foundation of the State agricultural experiment station at Sofia. Work was soon interrupted by the World War and was not resumed until 1922. Agriculture developed greatly in extent and in the increased number of new crops, and entomology became of greatly increased importance. However this work was confined very largely to the station at Sofia. Nevertheless the institutes for Viticulture and Forestry have done some work and the Royal Entomological Station founded for the investigation of the insect fauna of Bulgaria incidentally includes injurious insects. And in this connection the Bulgarian Entomological Society should also be mentioned.

The most outstanding of the Bulgarian authors have been the following: Dr. Jv. Bouresch, Al. Drenowsky, Iv. Georgieff, D. Iltscheff, D. Ioakimov, K. Malkoff, Prof. Z. A. Mokrzecki, V. Naidenoff, P. Petkoff, M. Rouskoff, P. Tschorbadjieff.

FINLAND

The semi-independence of Finland as a grand duchy, with the Emperor of Russia as Grand Duke, gave its Government jurisdiction

over most internal affairs, and therefore makes it necessary to treat it as a unit from the beginning of the development of applied entomology; and, of course, since the World War it has been an independent republic.

Work in economic entomology began in 1898. In that year there were founded in the University of Helsinki a faculty section of agriculture and an agricultural experiment station which included an entomological section. At first this section worked in the quarters of the Agricultural Department of the University, but in 1910 it was established in its own quarters about 10 miles from Helsinki. The Agricultural College had an associate-professorship of entomology which was occupied by Dr. Enzo R. Reuter. He was promoted to ordinary professor in 1901 and held the office until 1913 when he became Professor of Theoretic Zoology and was succeeded in his former chair by Dr. Walter M. Linnaniemi. In 1921 the latter was succeeded by Dr. Uuno Saalas, who had previously been a special lecturer on forest entomology at the University of Helsinki.

In 1924 the Agricultural Experiment Station was separated from the University and became an independent institution with a special section for the investigation of injurious insects, with a Director (Doctor Saalas), an assistant (Mr. Y. Hukkinen) and two special assistants (Messrs. N. Vappula and J. Listo). The facilities for work are good. Temporary field laboratories are established from time to time in the centers of insect outbreaks. A system of information exists which in certain years has 700 to 800 reporters.

From 1894 to 1916 yearly reports were issued in both the Finnish and Swedish languages. This series was interrupted by conditions brought about by the war, but I am informed by Doctor Saalas that Professor Linnaniemi has prepared a résumé of the insect damage from 1917 to 1923 which will soon be published.

In 1925 a plant-protection law was passed; and in 1928 the Council of Ministers altered the old laws against poisons so that at present the arsenical poisons, nicotine, the cyanide compounds, and so on may be used for agricultural and garden cultivation purposes.

SWITZERLAND

The Third International Congress of Entomology was held in Zurich, Switzerland, July 19-25, 1925. The President of the Congress, Dr. A. von Schulthess, in his opening address gave a brief summary of the famous Swiss entomologists of the past from the time of Sulzer (1761) down to the present. Among the more important of the older names were J. P. Fuessly, R. Schellenberg, Bremi, Escher-

Zollikofer, and Oswald Herr. Doctor von Schulthess had already written a series of interesting articles on the Swiss entomologists in the first half of the nineteenth century that were published as early as 1892 in the *Schweizer Entomologisches Anzeiger*. Among those to whom he gave especial attention were R. Myer-Duer (1812-1825), the coleopterist; the famous orthopterist, K. Brunner von Wattenwyl (1823-1914); E. Frey-Gessner (1825-1863); A. Goeldi (1859-1917), the famous writer, who lived most of his life in Brazil; and M. Standfuss (1854—), the man who did much interesting experimental work on the effect of temperature on the development of Lepidoptera.

Many famous entomologists still live and work in Switzerland.

At the Congress above mentioned were delegates from several Swiss institutions where work in applied entomology is being done today. Among these may be mentioned the Technical High School, the Swiss Agricultural Experiment Station, the Swiss Experiment Station for Orchard, Vine, and Garden Culture.

The published writings that include consideration of insects that have been found in Switzerland are very numerous. There was published in Berne in 1926 the seventh part of the *Fauna Helvetica* by the Swiss National Library. This seventh part includes the writings on Swiss insects in the years 1634 to 1900, and covers 292 pages.

As with other European countries, applied entomology received no especial consideration in Switzerland until the advent of the Phylloxera, and no important work was published about injurious insects prior to that time. Dr. H. Faës, of Lausanne, tells me that here and there short articles are to be found about the damage caused by grasshoppers in the canton of Valais in 1837-39, and so on. The Phylloxera, however, made its appearance in the canton of Geneva in 1874 and in the canton of Vaud in 1886; and the vine-growing industry in Switzerland was so important that strenuous measures were undertaken at once. In the *Fauna Helvetica* to which we have just referred, a long list of articles about the Phylloxera is printed, and I note that about 60 of them were published before 1878. The cantonal Viticultural Station of Lausanne which was founded in 1886 owed its origin to the appearance of the Phylloxera and that of the mildew. A history of the work of this station from 1886 to 1916 has been published by the station. It was written by Dr. H. Faës, Chief of the Division of Physiology, and Dr. F. Porchet, Chief of the Division of Chemistry. Doctor Faës' work includes phytopathology in the European sense that includes the insects as well as the diseases that affect plants. During the early years of the station interest in entomology was confined to the Phylloxera, and later to the *Cochylis* and *Eudemis*.

Now that these questions are measurably solved, the station is extending out more and more toward the study of insects injurious to fruit, and these studies are followed in all of the Federal agricultural establishments.

As early as 1909, the Association of Teachers of Agriculture in Switzerland published a little book by Doctor Faës entitled "The Maladies of Cultivated Plants and Their Treatment." It is a handy little book of 250-odd pages, with illustrations, and treats many forms of insects and plant diseases.

In German Switzerland there are three institutions, namely "Schweizerische Versuchsanstalt für Obst- Wein- und Gartenbau, Wädenswil; Schweizerische landwirtschaftliche Versuchsanstalt, Oerlikon/Zurich," and the Entomological Institute of the Federal Polytechnic School (O. Schneider-Orelli, Director) at Zurich. The results of the work of these stations are published in the Agricultural Yearbook of Switzerland and in the Swiss Journal for Orchard and Vine Culture, either in the form of annual reports or as original works. There is also the agricultural establishment of Liebefeld at Berne, which concerns itself with apiculture and diseases of bees.

As to forest entomology, we must refer to the large work, entitled "The Scolytids of Central Europe," by Dr. A. Barbey, printed at Geneva and Paris in 1921. This is an elaborate folio volume with excellent illustrations of Scolytid work and of the beetles themselves. Doctor Barbey has also published a Treatise on Forest Entomology (Paris, 1925). Although his book was published in Paris, Doctor Barbey is a Swiss. The volume (second edition) covers 749 pages, with 8 plates and 496 text figures.

There should also be mentioned the fine work on *le Hanneton* by Prof. M. Decoppet, formerly Professor at the Polytechnic School and Inspector General and Chief of the Division of Forests, Game and Fish in the Federal Department of the Interior. This volume, published in 1920, is a quarto of 130 pages, with 8 plates and very many maps. It includes a bibliography of the European cockchafer plagues from 1662 to 1920.

Quite a large number of papers relating to applied entomology have been published in Switzerland since the publication of Volume 7 of the *Fauna Helvetica*. The work done in German Switzerland has been very good. Since the beginning of the Review of Applied Entomology in 1912, 177 papers from Switzerland have been reviewed (down to September, 1929).

In 1926 there was published in the *Anzeiger für Schädlingkunde*, Volume 2, No. 9, pages 118-120, an important article by Professor

Schneider-Orelli entitled (translated) "Applied Entomology in Switzerland." He pointed out that the geological formation of the Swiss soil, of which about one-fourth is unproductive agriculturally, and the extraordinary climatic differences in the different sections afford remarkable faunal and biological problems. He showed that there is no opportunity in Switzerland for control measures on a large scale as in other countries. He referred to a paper published in 1833 by a Swiss physician, Dr. J. J. Hegetschweiler of Zurich, on the biology and control of the most important insects injurious to fruit trees. The omission of the woolly aphis in this paper indicates that the insect had not at that time reached Switzerland. A paper published by C. Bugnion and collaborators in 1841 on insects affecting grapes in the canton Waadt is also referred to, as well as the work of Oswald Heer on the May beetle. In 1859, Professor Schneider-Orelli states, the question was discussed among Swiss entomologists as to the advisability of paying more attention to the control of injurious insects, and the idea of publishing a book on injurious insects was also discussed. It was decided, however, that the practical application of entomology would always remain of secondary value. Then came the Phylloxera in the 1870's; and the names of Fatio, Muhlberg, Keller, and Goeldi are mentioned in this connection. After this, more and more attention was paid to injurious insects, and the publication in 1913 of Escherich's book on applied entomology in the United States had an influential effect on Switzerland. Doctor Schneider-Orelli refers to five governmental institutions in Switzerland working mainly in applied entomology.

The author of the summary just cited is not only a strong and successful teacher but also a writer of parts. A number of the important articles reviewed in the Review of Applied Entomology of recent years have been from his pen. He informs me in a recent letter that since the publication of his paper on the status of applied entomology in Switzerland in 1926 very appreciable progress has been made in that country. Forest entomology has become an obligatory subject of examination for forest engineers, and in the same way agricultural entomology is a required subject for all so-called agricultural engineers. Professor Schneider-Orelli also gives me the interesting news that the first student from the United States to pursue entomological studies in Switzerland will work in his laboratory the coming year.

SPAIN

A long paper entitled (translated) "Notes Concerning the History of Entomology in Spain" was presented by Señor D. José María

Dusmet y Alonso at the May, 1917, Congress of the Spanish Association for the Advancement of Science at Seville. This paper was published in full, and covers 74 pages. It divides its considerations into epochs. The first epoch is the period before 1776; the second one, from 1776 to 1871, and the third the period since 1871. The subject is, of course, treated in detail, and the facts concerning the museums and the publications are given, and also the names of the writers on Spanish insects, not only the Spanish writers but also those of other countries. The paper is of especial interest since it gives biographical data concerning many of the different writers, and, from the work as a whole, it is perfectly obvious that the insects of Spain are well known and that many first rate men have worked with them; moreover that Spain herself has developed some admirable entomologists. Of course, much of this was well known to the entomological world, and all recent entomologists know the work of the elder Bolivar and of Father Navas and a number of others.

This paper by Dr. Dusmet y Alonso was reprinted in part in the (translated) Bulletin of the Entomological Society of Spain, Volume 2, No. 3, pp. 74-84, March, 1919; No. 4-5, pp. 87-98, April-May, 1919; No. 7-8, pp. 161-195, October-November, 1919.

The injurious insects of Spain have been, in the main, those of the south of France and of Italy, and the old-time remedies were known in this country quite as well as they were in the others. There seemed no reason why active investigations of economic entomology should be taken up in that country; all the more so since any results obtained in the other Mediterranean countries could be readily adopted there. Thus, while, as we have shown, Spain has developed a number of very excellent entomologists, as a country she entered the field of economic entomology at a comparatively recent date.

In 1893 a very large book was published entitled "*Insectos y Criptógamas que Invaden los Cultivos en España.*" It was written by D. Castildo Ascárate y Fernández, Agricultural Engineer, and is divided into two parts. The first part, that treats of insects only, covers 336 pages; and the fungus diseases added to this make the entire book to cover 780 pages. It is the largest size octavo, and is illustrated fairly abundantly, the illustrations for the most part apparently being drawn from other works. The more conspicuous of the injurious insects of Spain are considered, and the work was fairly well up-to-date for that period. The early portions treat of the anatomy and classification of insects, and these are then considered in their relations to crops. Apparently this book covered the field in a satisfactory way, and although some years later a phytopathological

station was established near Madrid the work was directed more towards plant diseases than injurious insects.

When I visited Madrid for the first time, in 1910, I had the pleasure of meeting the veteran orthopterist, Ignacio Bolivar and, in company with El Conde de Montornes, visited this phytopathological station not far from Madrid. There I found Leandro Navarro, who, although much more interested in plant diseases, did what entomological work was necessary. In fact, there did not seem to be at that time any general demand for work in economic entomology. However, the economic argument was already being used to increase the funds requested from the government for the support of the Museum of Natural History, and in this way an expert Dipterist and an expert in parasitic Hymenoptera were added to the staff of the Museum and were sent, the one to study with Kertész in Budapest and the other with Schmiedeknecht in Germany, on the basis of the argument that these men would be able to study competently the parasitic insects which would hold the injurious forms in check.

Later, damage by the gipsy moth and by various other species started more efficient work. It is possible that the visits of several entomologists from the United States, in search of parasites of the gipsy moth and the brown-tail moth, may have helped in the movement. Surely the damage done by certain scale insects to Citrus plantations, which began to be very noticeable about 1909, excited much interest, and American remedial methods were sought for and introduced. R. S. Woglum, of the Bureau of Entomology at Washington, on his way to India to search for parasites of the so-called white-fly of Florida, stopped at Gibraltar in 1910, went up to Valencia at the request of the Spanish Government, and instructed Spanish agricultural engineers in fumigation by the use of tents as practiced in southern California.

From that time on, progress has been rapid. The young Bolivar (Candido) turned his attention more to economic entomology. Research stations were started in several provinces, and much work of a sound character is now being done. D. D. de Torres, receiving a traveling fellowship from the International Education Board, came to the United States in 1927 and remained until after the Fourth International Congress of Entomology at Ithaca in August of 1928.

The Bulletin of Vegetable Pathology and Agricultural Entomology, published regularly by the National Institute of Agronomical and Forest Investigation and Experiment, contains full reports from each of the stations above mentioned which show a high degree of excellent work.

This Bulletin was started in January, 1926, and contains special articles relating to economic entomology by J. Nonell, M. Beniloch, P. Herce, J. M. Berro, E. Ibarra, F. Gomez Clemente, C. Arroniz, M. Sanchez, A. Cabrera Diaz, D. D. de Torres, J. del Canizo, and others. The Bulletin also contains in each number an excellent bibliography in which reviews of important works are given with some detail. In the last number received at Washington in October, 1929 (the number for December, 1928) there is a long and interesting article by De Torres on the plant-inspection system as it functions in the United States and Canada. There is also a very interesting and well illustrated article on the acclimatization in Spain of *Cryptolaemus montrousieri*, by F. Gomez Clemente; and another, on a plague of melons (*Epilachna chrysomelina*) by Del Canizo; while Beniloch and Herce have articles on insecticides, and Del Canizo one on the codling moth. There is also an obituary notice of Leandro Navarro, whom I met in Madrid in 1910.

This Bulletin of Vegetable Pathology and Agricultural Entomology was preceded for the years 1923 to 1925 by the Revista de Fitopatologia, of which three volumes were published. This was called the organ of the Service for the Study and Extinction of Forest Plagues under the Director of the Laboratory of Spanish Forest Fauna, D. Manuel Aullo y Costilla. This Revista contained a number of entomological articles, including publications on parasites by R. Garcia Mercet; others by C. Bolivar y Peltain, and others. Among them is an important article on the gipsy moth by the Director, M. Aullo. This publication continued through 1928, when it was apparently changed in some respects, and there was begun in October, 1929, the publication of the Revista de Biologia Forestal y Limnologia, which is termed the Second Series of the Revista de Fitopatologia. The first number is entitled "Series A. No. 1."

The Bulletin of the Royal Spanish Natural History Society has contained entomological articles of economic importance from time to time. Thus, in 1925, it contained articles of this nature by Escalara, Garcia y Mercet, Sanchez y Sanchez, and De More.

PORTUGAL

Portugal is one of the South European countries in which wine-growing has always been one of the more important agricultural industries. The wines of Oporto, for example, have long been famous. Naturally, then, the advent of the grape-vine Phylloxera created a great stir in this country. Work in economic entomology was hardly known before the Phylloxera came. The general interest

in the problem of this new enemy of the vine was very great from the start. The agricultural newspapers of the period were filled with notices of the ravages of the pest and with observations and instructions relative to the means of combating it that had been proposed not only in Portugal but also in foreign countries. Especial studies were made of the hitherto unknown plague, and laws and regulations were promulgated by the Government just as they were by governments in many other parts of the world but especially in Europe.

Governmental investigation was not begun for a long time. The Portuguese, however, followed closely everything that was being done in France. Questions relating to crop pests were handled in a way, at the Agricultural Institute by Professor Verissimo d'Almeida, while Profs. Barbosa du Bochage and Matoso Santos of the University at Lisbon and Paulino d'Oliveira and Lopes Vieira of the University of Coimbra studied the plant parasites that were brought to them by farmers or sent to them in correspondence.

In 1899, however, Carlos LeCocq, then Agricultural Engineer, organized the Laboratory of Vegetable Pathology and installed it in the building of the Ministry of Agriculture. It was composed of two sections, one for cryptogamy and the other for entomology. It was a good working organization, each section having a chief (trained as an Agricultural Engineer) and each was aided by a preparator and auxiliary personnel. Senhor LeCocq was afterwards made Director General.

The newly founded laboratory was for some time in a very flourishing condition, and many species of injurious insects were studied, and remedies put into effect. The incident which first brought this laboratory and the Bureau of Entomology at Washington together was as follows: The white or fluted scale, *Icerya purchasi*, in the late 1880's made its appearance in the orange and lemon groves along the banks of the river Tagus in Portugal. It multiplied enormously, and disaster was threatened. In September, 1896, the attention of the Washington Bureau was drawn to this matter by Senhor Armando da Silva. In reply, I suggested the importation of the Australian ladybird, *Novius cardinalis*, and while awaiting his reply I received a letter from Senhor LeCocq, with whom Senhor da Silva had been in communication and with whom the subsequent correspondence was carried on. There was newspaper discussion of the matter in Portugal, and I am informed that many prominent persons over there thought that the California experience was based on untrustworthy evidence and that the whole matter was an instance of Ameri-

can *réclame*. Senhor LeCocq, however, thought differently, and in October, 1927, the writer was able to secure, through the State Department of Horticulture of California, 60 adult Novius and some larvae. Only five of these reached Portugal alive, but Senhor LeCocq was able to rear many others from them. A second sending was started on the 22nd of November, and six adults arrived safely. From these were reared under Senhor LeCocq's supervision and with great care so many of the little beetles that they were soon distributed to orange growers with the result that the scale insects were completely subdued. An account of this rather extraordinary incident, with a translation of Senhor LeCocq's story of the Portuguese end, will be found in Bulletin 18, new series, of the United States Bureau of Entomology, pages 30-35 (November, 1898).

I had the pleasure of visiting Lisbon in 1910. Senhor LeCocq, then Director of Agriculture, introduced me to Prof. A. F. de Seabra of the Phytopathological Station at Lisbon. Senhor de Seabra interested himself greatly in the object of my mission (the European parasites and natural enemies of the gipsy moth and the brown-tail moth) and we had a long talk on entomological matters of mutual interest. I am greatly indebted to him for most of the facts upon which this account of activities in Portugal is based. In 1923 I had the pleasure of meeting him again, at Madrid, at an international olive-fly conference held under the auspices of the International Institute of Agriculture at Rome. He was one of the representatives of Portugal at this important conference.

In 1910 the growing work of the Laboratory began to decline. Reorganizations of all the public services were made at that time, since the present Republic of Portugal was formed that year, and the progress of technical work was somewhat hampered. However, the Laboratory of Vegetable Pathology having been installed at the Agricultural Institute of Lisbon, it continued its investigations under the direction of Prof. Verissimo d'Almeida.

I have seen an interesting and important article entitled (translated) "The Principal Lepidoptera Injurious to Agriculture in the Neighborhood of S. Fiel," published in *Broteria*, Salamanca, 1913 (Ser. Zool. vol. 9, pp. 40-44).

In 1916 Senhor de Seabra was charged with the organization of a Laboratory of Forest Biology. There was an old laboratory, belonging to the Forest Service, in which the Agricultural Engineer, Camara Pestana, had made some very interesting studies on the disease of the chestnut, and certain forest engineers, such as Mendes, d'Almeida and others, had also done some work on forestry biology.

After the organization of the Laboratory by De Seabra its investigations were especially occupied with entomological subjects. Interesting studies have been made upon the oak Tortrix and upon the gipsy moth and brown-tail moth; also upon the European elm leaf beetle and several other insects injurious to trees; and at the same time studies have been carried on concerning the general fauna of the forests. A special Entomological Section has been started at Coimbra.

At the present time the Laboratory of Vegetable Pathology still has approximately the old organization, but has a more numerous technical personnel and is well installed in the new building of the Superior Institute of Agronomy at Lisbon under the direction of Prof. Sousa da Camara. This Laboratory was represented at the international olive-fly conference at Madrid in 1923, and has made investigations on this injurious insect.

Aside from these activities of the general government, I am informed that there has just been organized in the Museum of the University of Coimbra a special Section of Biology and Parasitology publishing archives and also occupying itself with the study of parasites of plants. Moreover the Museum of the University of Porto has established an insectorium at Foz do Douro in which the species injurious to agriculture will be studied.

Under the titles (translated) "Publications of the Laboratory of Vegetable Pathology" and (translated) "Works of the Laboratory of Plant Biology," a number of studies, instructions, etc., have been published since the organization of these institutions. And apropos to the different plagues of agriculture, the Government has issued laws and special instructions. Quite recently an edict has been promulgated regulating the services destined for the fight against the Argentine ant.

More or less entomological work of one kind or another has been done in the Portuguese colonies. About the time of the revolution, Mr. G. H. Gable, of the United States Federal Bureau, for example, was sent to the Azores. Later, C. W. Howard was sent from the United States to Portuguese East Africa. During 1928 and 1929 M. P. Lesne, a very well known entomologist of the Paris Museum of Natural History was resident in Mozambique studying insect pests, especially those of cotton.

In 1916 a colonial agricultural company entitled (translated) "The Overseas Agricultural Company" established a Laboratory of Entomology and Phytopathology at Lisbon. This laboratory was well organized, and sent a trained Agricultural Engineer to San Thomé to make studies of the cacao and other cultures of that island and to

send to the Lisbon Laboratory the necessary material for study. This laboratory has published reports and scientific memoirs in the (translated) "Memoirs of the Portuguese Society of Natural Sciences," and also some of its papers have been privately published by the company. A large quantity of entomological material has been gathered, and it has been identified not only at Lisbon but at London and Paris by well known specialists, and may be found in the Colonial Museum at Belém, Lisbon.

Professor de Seabra in the early 1890's studied in Paris. He took courses in natural science at the Sorbonne, at the Museum of Natural History and at the École Pratique des Hautes Études; and with the founding of the Laboratory of Vegetable Pathology under the Ministry of Agriculture at Lisbon he joined the force as Preparator; and in 1905 was made Chief of the Entomological Section. Professor de Seabra is now (December, 1929) a man of 55 years who has done much entomological work of importance although he has covered not only the field of agricultural zoology but has done considerable phytopathological work. His list of publications covers more than 160 titles and includes not only papers of economic bearing, but also the results of important work in taxonomy.

GREECE

The Grecian Government did practically nothing in the way of encouraging research in economic entomology or in helping the Grecian agriculturist to avoid insect damage until political affairs began to stabilize themselves after the conclusion of the World War. Such information as the comparatively few scientific men of that country and the more progressive of the agriculturists could gain from foreign publications was utilized; and this was the only source. It is true, however, that when a Ministry of Agriculture was founded in 1910 the first person to be appointed Minister, Emmanuel Benachi, called together the most competent men for consultation on this point, and the general opinion seemed to be that a special phytopathological service should be started. Some move was made in that direction, and shortly afterwards Dr. C. Isaakides was appointed an inspector and visited the phytopathological institutions at Gembloux, at Paris, and at Florence. I had the pleasure of meeting him in 1912 in the laboratory of Paul Marchal at Paris. In 1914 he had begun active work; and then came the war.

It was not until 1923 that the Central Phytopathological Service was organized under the decree of May 26. This service has been in active operation since that time, and has been supplemented by the establishment of regional laboratories in Thessaly, Peloponesis, and

Crete. No special entomological bureaus have been established, and the men so far engaged are acquainted with the general features of both phytopathology and agricultural entomology.

The present year (1930) a phytopathological institute at Kiphissia, a suburb of Athens, 14 kilometers northwest of the city, was opened and started operations. It is known as the Benakion Phytopathological Institute, and was erected and equipped with funds left by the late Emmanual Benakis. The purpose of the Institute is research work in the fields of entomology and plant pathology. In addition to this research work, graduate students of the agricultural colleges of Athens and Salonica may take postgraduate work here. Building operations were started in 1927, and the actual operation of the Institute, under the direction of Professor Isaakides, was started in January, 1930.

This late information has been given to me by Mr. John Hadji Nicolaou, who spent most of the year 1929 in the United States studying economic entomology largely with Prof. T. J. Headlee at New Brunswick, New Jersey, but who also has done work in the University of California and at its southern branch at Riverside. He is now (April, 1930) about to return to Greece to take up work in economic entomology under the Department of Agriculture of the Government.

CYPRUS

Like all countries around the eastern Mediterranean, the island of Cyprus has been subject to locust invasions from time immemorial. Mr. H. M. Morris, at present Government Entomologist, has been good enough to send me a copy of two pages from the "Handbook of Cyprus" by Luke and Jardine (Macmillan, 1920), and we quote here the following paragraph concerning early days:

Locusts. The earlier modes of attack were at least quaint. Under Hugh I (1205-1218) an icon representing SS. Christopher, Tarasius, and Tryphon was carried processionally to meet the advancing swarms, and the crops were saved. In 1411 a priest who was cursing them was suffocated by locusts. In 1473 we hear of water brought in open vessels from Kerkük, in Persia: this attracted a flock of "red and black birds, which, flying together like starlings, with their song and flight destroyed the locusts." In 1688 the Panagia of Kykko was invoked to bring these birds, which were perhaps the russet starling (*Pastor roseus*). In 1628 Archbishop Christopoulos begged the abbot of the Laura on Mount Athos to send him the head of S. Michael, sometime Metropolitan of Synnada in Phrygia, and a martyr under Leo the Isaurian about 814, to stay the plague.

In 1881, however, special legislation was passed to provide funds for a war of extermination, and between July of 1881 and July of

1882 30,000 pounds was expended on the campaign. One thousand, three hundred and five tons of eggs were destroyed at a cost of nearly 12,000 pounds. Then the screen and pit system was adopted, which became generally known as the Cypriote method and has been of great use ever since. In fact it has been used the present year in eastern Egypt and in Transjordan. In 1883, it is stated, two hundred thousand kilos of locusts were destroyed in this way.

From 1896 to 1905, P. Gennadius (a Greek) was Director of Agriculture in Cyprus, and corresponded with the Bureau of Entomology in Washington. Although not distinctly an entomologist, he was a very well informed man and carried on some entomological work. He was succeeded by another Greek, D. Saracomenos, until 1911. A Cypriote, Z. I. Solomides, was Entomologist from 1914 to 1920, but was only a junior officer. He was succeeded by a fellow countryman, G. A. Mavromoustakis, who held office in 1921 and 1922. In 1923 an Englishman, Mr. D. S. Wilkinson, was appointed Government Entomologist, and remained until 1926. Through his efforts, the rather abundant legislation in force regarding insect pests was reformed and new legislation was adopted. He made studies of the codling moth, of *Eurytoma amygdali*, and especially of *Thaumetopoea wilkinsoni*, publishing a long account of the latter insect in the Bulletin of Entomological Research for October 2, 1926. Mr. Wilkinson is now a Senior Assistant in the Imperial Bureau of Entomology at London.

In the beginning of 1927, Mr. H. M. Morris was appointed. Mr. Morris was a well known worker on several important problems in economic entomology who had been connected with the Rothamsted Experimental Station at Harpenden, England, and who has done some excellent work in Cyprus since his arrival. The island produces wheat, cotton, Citrus fruits, and apples, all with the usual pests, and, as Mr. Morris writes me, there are also locusts and rats to be dealt with. He finds himself so busy that he has little time for research.

PART III

ASIA

JAPAN

With the modernization of this important country, entomology received rather early attention, but it was really not until after some of the early students, especially selected for their intellectual qualities, had begun to return from Europe and the United States that applied science in many directions began actively to move. The writer was a student at Cornell with the brilliant botanist, R. Yatabe, for example, whose greatly lamented death occurred all too early, when his work at the Imperial University was becoming notable. There were later traveling students who went into entomology.

Silkworm culture is one of the oldest industries in Japan, and consequently there has always existed in that country a familiarity with insects that does not exist in other countries. Insect subjects, for example, were often used by Japanese artists, especially in the old days. The accuracy of some of these old drawings is very impressive and leads one to believe that the Japanese are naturally very keen observers of details as well as of larger things.

Prior to 1867 insects were studied in Japan principally as to their use in medicine. They were used for medical purposes very extensively, and in fact still are so used.¹ As late as 1919 Miyake published an important paper entitled "Investigations upon Insects Used for Food and in Medicine." Some excellent zoologists and morphologists were developed at an early day, notably Mitsukuri and Watase. In 1880 the Tokyo Zoological Society was organized, and for a period of years entomological papers appeared in its magazine. Mr. C. P. Clausen informs me that Doctor Ishikawa began the publication in this magazine of a series of articles entitled "Stories about Insects" which were widely read; and the magazine was used in place of books on this subject as none had been printed at that time in Japanese. In 1898 was published Matsumura's "Entomology of Japan," the first book confined to insect classification to be published in that country. It aroused a great interest in entomology, and many publications followed.

Kakichi Mitsukuri, the eminent Japanese zoologist and embryologist, was born in 1857. He came to the United States in 1873; took his doctorate in philosophy at Yale in 1879 and at Johns Hopkins

¹ In an important monographic paper on gall-producing aphides and their galls, by Prof. Kota Monzen, published in May, 1929, the statement is made that Ranzan Ono described a sumach gall in 1802 stating that the gall "was inhabited by small insects and was utilized by women to dye their teeth!"

in 1883. He became Professor of Zoology in the University of Tokyo in 1882. In 1893 he was made a Councillor of the University, and in 1901 Dean of the College of Science, which position he held until 1907. He died in 1909.

Mitsukuri, from his researches, became well known to all zoologists, and he did great work in the training of students who entered many different departments of entomological investigation. He brought together a very large collection of Japanese insects which were sent to the Columbian Exposition at Chicago in 1893. They were most of them subsequently presented to the United States National Museum and received the attention of a large number of specialists, among them the late W. H. Ashmead.

Mitsukuri was much more than a broad zoologist; he was a high-minded, broad-thinking, patriotic citizen of Japan. In 1897 he visited the United States and gave a course of lectures before the Lowell Institute in Boston on the subject of "The Social Life of Japan." These lectures were subsequently published, and in 1922 were translated into French by Prof. M. Miyajima and published by the Franco-Japanese Society of Paris. No one who reads one of these books can fail to be impressed more than ever before by the high ethical spirit of the better type of Japanese life, and especially by the training of the children which fits them to become the highly efficient people the Japanese have shown themselves to be in many ways.

Applied entomology was somewhat in advance of systematic entomology, and a book on injurious insects was published by Fukuhara in 1882. Later, Ono published his "Introduction to Applied Entomology," and volumes on insects by Sasaki and Matsumura were published in 1899.

The first lectures on entomology were given in 1880 at the Komaba College at Tokyo by K. Neruki, and in 1882 Dr. C. Sasaki began his work there which concerned itself principally with research upon silkworms and which continued until his retirement in 1920. Sasaki's early research work upon the Tachinid parasite of the silkworm, which he called *Ujimyia sericaria* and which caused a mortality among silkworms to which had been given the name in Japan of the *uji* disease, was astonishing to the entomological world in the novelty of its results, and his early announcements met with general incredulity. They were later abundantly confirmed by the work of C. H. T. Townsend and others; and the old ideas of the bionomics of the Tachinidae have been vastly modified.

At the Sapporo Agricultural College (now the Hokkaido Imperial University) lectures were given by Nozawa and Hashimoto prior to Doctor Matsumura's coming in 1895.

A very interesting and important entomological laboratory had started at Gifu in 1897 by Y. Nawa, a native who had not studied abroad. He built up an excellent laboratory and founded a journal which was continued for many years. It has been widely distributed, but, owing to very general ignorance in other countries of the Japanese language, only its excellent line illustrations and the Latin names of the insects have been intelligible as a rule.

About 1900 there was a great extension of teaching and research in entomology to all of the Government agricultural colleges and agricultural common schools, and numerous experiment stations were started. The following is a list of institutions that either teach entomology or engage in entomological research at the present time:

DEPARTMENT OF EDUCATION	Entomologist or Dept. Head
Tokyo Imperial University	
Kyoto Imperial University	Dr. H. Yuasa.
Kyushiu Imperial University, Fukuoka.....	Prof. T. Esaki.
Sendai Imperial University, Sendai.....	
Hokkaido Imperial University, Sapporo.....	Dr. S. Matsumura.
Taihoku Imperial University, Taihoku, Formosa....	Dr. T. Shiraki.
Chosen Imperial University, Keijo, Chosen.....	
Morioka College of Agriculture and Forestry, Morioka.	Prof. T. Monzen.
Kagoshima College of Agriculture and Forestry, Kagoshima	Prof. G. Okajima.
Tottori Agricultural College, Tottori.....	Prof. S. Inomata.
Utsunomiya Agricultural College, Utsunomiya.....	Prof. B. Shibata.
DEPARTMENT OF AGRICULTURE AND FORESTRY	
Bureau of Agriculture, Tokyo.....	Mr. I. Kuwana.
Imperial Central Agricultural Experiment Station, Nishigahara, Tokyo	Mr. S. Kinoshita.
Sericultural Experiment Station, Nakano.....	Dr. H. Yokoyama.
Bureau of Forestry	Mr. S. Yano
Forestry Experiment Station, Meguro, Tokyo....	Mr. S. Yano
DEPARTMENT OF FINANCE	
Imperial Plant Quarantine Service.....	Mr. I. Kuwana.
STATIONS UNDER THE PROVINCIAL GOVERNMENTS	
Hokkaido Agricultural Experiment Station, Kotoni, Sapporo	Mr. S. Kuwayama.
Okayama Agricultural Experiment Station, Okayama..	Mr. S. Matsumoto.
Shimane Agricultural Experiment Station, Shimane..	Mr. R. Nozu.
Niigata Agricultural Experiment Station, Nagaoka..	Mr. S. Takahashi.
Fukushima Agricultural Experiment Station, Fukushima	Mr. K. Ito.
Shizuoka Agricultural Experiment Station, Shizuoka..	Mr. K. Yoshida.
Wakayama Agricultural Experiment Station, Wakayama	
Chosen Agricultural Experiment Station, Chosen (Korea)	Mr. S. Nakayama.

STATIONS UNDER THE PROVINCIAL GOVERNMENTS		Entomologist or Dept. Head
Taihoku Agricultural Experiment Station, Taihoku, Taiwan (Formosa)		Dr. T. Shiraki.
Chosen Forestry Experiment Station, Keijo.....		Mr. J. Murayama.
PRIVATE LABORATORIES		
Nawa Entomological Laboratory, Gifu.....		Mr. U. Nawa.
Ohara Institute für landwirtschaftliche Forschungen Kurashiki, Okayama		Dr. C. Harukawa.

This list has been given me by Mr. C. P. Clausen, who has spent some years in Japan recently and who has also been good enough to furnish me with the following facts:

The leading university in respect to entomology is that of Hokkaido, with Dr. S. Matsumura as head of the department. The lead taken by this university may be attributed to the fact that when organized 52 years ago it was headed for a short time by President Clark of Amherst, and for a number of years a considerable number of the staff were American. Doctor Matsumura, upon graduating from this university (then the Sapporo Agricultural College, later the Tohoku Imperial University, and finally the Hokkaido Imperial University), spent several years abroad in study and returned in 1893 to hold the newly established chair of entomology. He has served continuously since that time and has built up by far the largest collection of insects in Japan, in fact this is the only comprehensive collection in the country today. The university has recently completed a concrete fire-proof building solely for the housing of this collection.

For many years the Hokkaido University was the only institution in Japan giving training in entomology, and consequently a large proportion of the leading entomologists of the present day received their training under Doctor Matsumura, notable among them being Doctors Shiraki and Okamoto.

Doctor Matsumura is a most extensive writer, his best known writings being the three volumes on economic entomology and the twelve profusely illustrated volumes under the title "Thousand Insects of Japan." In addition he has described several thousand species covering practically every order. He speaks and writes both English and German with considerable facility. Working under Doctor Matsumura is Mr. T. Uchida, who is engaged primarily in a study of the Ichneumonoidea.

As in practically every country the early work in entomology was largely along systematic lines, and the work at Sapporo is still being confined entirely to this line. At other institutions there is now developing quite a pronounced leaning toward the biological phases of the subject.

The Tokyo Imperial University, with its College of Agriculture at Kamabe, has no department of entomology and at present no entomologist on the staff. Mr. Yano of the Forestry Experiment Station at Meguro delivers a course of lectures there, but nothing further is offered at present. Dr. C. Sasaki was for a period of years professor of entomology at the college but retired in 1920. His work has been largely upon silkworms, and it was while a member of the staff of the Sericultural Experiment Station at Nakano that he made his investigations upon the Tachinid, *Ugimya sericariae*, and published in 1887 his account of the unusual life-history of this parasite, in which was demonstrated for the first time the habit of leaf-oviposition.

The entomological department at Kyoto Imperial University was organized in 1923 with Dr. H. Yuasa, who studied for many years in America and took his doctorate at Illinois, as its head. He is known primarily for his work upon the larvae of the saw-flies.

The newly organized Taihoku Imperial University in Taiwan (Formosa) has Dr. T. Shiraki as head of the division of entomology and zoology. He also holds the position of chief of the division of economic zoology at the Government Research Institute and entomologist at the Taihoku Agricultural Experiment Station. His best known publications are a large volume on the general economic insects of Formosa and one of several hundred pages reviewing the cotton insects of the world.

The remaining three of the Imperial universities have no provision at present for teaching or research in entomology.

The Imperial Central Agricultural Experiment Station at Nishigahara, Tokyo, was at one time the leading institution in research in economic entomology in Japan, with Dr. T. Miyake and Mr. Kuwana on the staff. Upon Kuwana's transfer to quarantine work in 1914 and the death of Doctor Miyake in 1920 the activities of the entomological section declined. The station, however, is now being reorganized and will move into a fine new building next month, and it is anticipated that the research work of the institution will now be much extended.

The leading provincial experiment stations as far as entomology is concerned are those of Hokkaido, Okayama, and Wakayama in Japan proper, and at Taihoku, Taiwan (Formosa), and Suigen, Chosen (Korea). The Hokkaido station at Kotoni, Sapporo, of which Mr. S. Kuwayama is the entomologist, is doing extensive work upon field crop and deciduous fruit insects, and a number of extensive publications have been put out in recent years. The Shizuoka station confines itself largely to Citrus problems, but the remaining ones listed cover the entire field, with perhaps greater attention being paid to insects affecting rice.

Of the private institutions the Nawa Entomological Laboratory at Gifu is the oldest and best known. Established by the late Y. Nawa, it is now being conducted by his son, U. Nawa. Among other things there is published by this laboratory *Konchu Sekai* (Insect World) now in its 32nd volume, as well as a number of volumes of taxonomic work, largely on Lepidoptera, by K. Nagano. The income of the laboratory is supplemented by the manufacture and sale of various household articles artistically decorated with the wings of butterflies and moths and other insects also. They have developed a process whereby the scales from the wings of Lepidoptera can be transferred direct to any desired surface, and the coloring and texture is thus identical with the actual specimens.

The second of the private laboratories is the Ohara Institute at Kurashiki, which is engaged primarily in research along economic lines. Dr. C. Harukawa, who studied for a time at the University of Illinois, is the entomologist, and has published a series of papers dealing with *Laspeyresia molesta* and various other deciduous fruit insects, as well as upon some affecting rice.¹

¹ The Ohara Institute for Agricultural Research is an important organization. Its publications have been mainly printed in German with the title (translated) "Proceedings of the Ohara Institute for Agricultural Research." M. Kondo is the Director of the Institute, and some of the articles are written in the German language. The majority of them are written in English. The Institute has a

One of the more prominent entomologists of Japan, not given in my list, is Dr. H. Okamoto, who prior to 1921 was entomologist of the Hokkaido station, and, until 1924, of the Chosen station. Since that time he has been without an official position. His systematic work has been largely upon the Lepidoptera, with biological and control studies on various deciduous fruit insects.

Aside from the publications of the various experiment stations, entomological papers in Japan appear very largely in the following periodicals:

IN FOREIGN LANGUAGES ONLY:

Journal of the College of Agriculture, Tokyo Imperial University, Tokyo.

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo.

Transactions of the Sapporo Natural History Society, Sapporo.

Berichte des "Ohara Institute für landwirtschaftliche Forschungen," Kurashiki, Okayama.

IN JAPANESE ONLY:

Konchu Sekai (Insect World), Nawa Entomological Laboratory, Gifu.

Dobutsugaku Zasshi (Zoological Magazine), Zoological Society of Japan, Tokyo.

Byochu-gai Zasshi (Journal of Plant Protection), Plant Protection Society, Tokyo.

Byokugaichu Iho (Journal of Pathology and Entomology), Department of Agriculture and Forestry, Tokyo.

Sapporo Norin-gaku Kwaihō (Transactions Sapporo Society of Agriculture and Forestry), Sapporo.

Dai Nippon Nō Kwaihō (Journal of Agricultural Society, Japan), Tokyo.

Several other entomological journals have been published in the past but were eventually discontinued, so that Konchu Sekai is the only one now remaining devoted entirely to entomology.

At the Formosa Experiment Station Mr. R. Takahashi is publishing an extensive series of papers in English on the Aphididae of Formosa.

This last paragraph quoted from Mr. Clausen reminds me that the Formosa Experiment Station has been doing especially good work for a number of years. Dr. T. Shiraki visited this country in 1909, and, both before his visit and later, published a number of good papers. I especially remember one on insects affecting growing rice, in which the rice stem borer (*Chilo simplex*) was treated among other forms. An especially interesting report was published from this station in 1916 on the injurious insects of the mulberry tree in Formosa. The author was M. Maki. The book covered 265 pages, with 24 text figures and 14 plates. The number of insects attacking this important tree in Japan appears to be very great, and they appear

rather large organization, carrying specialists in forest bacteriology, plant pathology, and entomology, with a corps of assistants numbering about 15 in 1929. Doctor Harukawa has been connected with the Institute since 1917 and has published many important papers. He is considered by some of the Japanese workers to be practically the foremost economic entomologist in Japan.

to have been studied carefully by the author of this work. Professor Shiraki spent 1927 and a large part of 1928 in foreign travel. In 1927 he spent some time in Berlin and at other points in Europe. I was glad to meet him in June of that year in the British Museum of Natural History. In September we were both at the International Congress of Zoology at Budapest. And in 1928 he returned to Japan by way of the United States, was a delegate to the Fourth International Congress of Entomology at Ithaca, and later visited the Federal Bureau of Entomology at Washington.

Mitsukuri, one of the greatest of the early Japanese zoologists, visited the United States as early as 1880 and made many friends. He had been a student of E. S. Morse, one of the famous students of the elder Agassiz, who went to Japan and lectured on zoology in the Imperial University of Tokyo in the early 1870's. Mitsukuri, although a broad zoologist, was greatly interested in insects, and he sent a very large collection of Japanese insects to the World's Fair at Chicago in 1893. This collection in its entirety came to Washington, and portions of it were worked up by different specialists, the Hymenoptera in particular being very well handled by the late Dr. W. H. Ashmead. And Mitsukuri himself visited this country in the late nineties and spoke before the Biological Society of Washington.

About 1899, S. I. Kuwana, who had been a student at Stanford University and who had paid especial attention to the scale insects, went back to Japan. It was at a time when the original home of the San Jose scale was under dispute, and Kuwana, finding it abundant in many orchards in Japan, announced that in his opinion the insect must originally have come to America from that country.

Dr. C. L. Marlatt, of the United States Bureau of Entomology, who had been paying especial attention to the San Jose scale, was not perfectly satisfied with this conclusion, and in 1900 started on a long trip around the world in the course of which he proposed to settle, if possible, this question of the original home of the scale. He visited Japan first, and it may be stated at once that he decided that Japan got the scale from the United States rather than the reverse, and he eventually found what seems with little doubt to be the original home in north China. However, Doctor Marlatt's visit to Japan really started a more personal contact between the Japanese workers and those of this country than had existed before. He was received with extreme courtesy. A skilled Japanese student, Mr. Hori, was nominated by the Government as his traveling companion. He visited Y. Nawa at his entomological laboratory at Gifu, and explored many parts of the Japanese archipelago. Professor Kuwana greeted him in a fraternally hospitable way and helped him,

as did all the Japanese scientific men whom he met, to the extent of his ability. Professor Kuwana's long residence in California and his admirable English, of course, made him of great assistance.¹

Again in 1908 Prof. Trevor Kincaid was sent to Japan to study the parasites of the gipsy moth and the brown-tail moth. While his expenses were paid by the State of Massachusetts, he traveled as an authorized representative of the United States Department of Agriculture. Both officially and personally, he was received with extreme courtesy and hospitality. His work was facilitated in every possible way. The Department of Agriculture of the Japanese Government authorized Professor Kuwana to assist in the work, and after Professor Kincaid returned to the United States shipments of the parasites were continued by Kuwana for a long time and without expense to the United States.

Then Japanese entomologists began to come to America more numerous—some to study at the different universities; others, already well trained, to look into the different aspects of applied entomology as practiced in this country. One of the early arrivals was T. Shiraki, from Formosa, who arrived in 1909; and from that time on there have been one or two almost every year to visit Washington and some of the other entomological points of interest in the United States. A list of those who happened to register in my office is appended.

T. Shiraki, 1909, Formosa.

C. Sasaki, November 29, 1910, Zool. and Ent., Imp. Univ., Tokyo.

J. Omori, December 1, 1911, Zool. and Ent., Imp. Coll. Agr., Morioka.

T. Ito, February 18, 1914, Chief, Plant Industry, Dept. Agr. and Commerce, Tokyo.

G. Okajima, April 19, 1916, Prof. Ent., Kagoshima.

M. Oshima, August 12, 1918, Zool., Govt. Inst. of Science, Formosa.

M. Miyijima, August 13, 1919, Kitasato Inst.

S. I. Kuwana, September 20, 1919, Dir., Plant Quarantine Sta.; Ent., Imp. Agr. Ex. Sta., Tokyo.

S. Matsumura, December 13, 1920, Imp. Univ., Hokkaido.

M. Koidzumi, May 18, 1921, Inst. of Sci., Formosa.

N. Ishimori, April 8, 1922, Asst., Imp. Univ., Tokyo.

C. Harukawa, May 12, 1922, Ohara Inst., Kurashiki, Okayama.

¹ Doctor Marlatt writes me under date of January 14, 1929, "I recall vividly the courtesies which were received from entomologists in all the principal sections of Japan which I have visited. It would be almost invidious to mention by name, but I have a very particular souvenir of the courtesies and very friendly personal interest and aid which was given me by those fine old Japanese professors, Doctors Mitsukuri and Watase. The former gave me particularly an insight into Japanese thought and courtesy which will always be a pleasure to me to recall."

- S. Hozawa, September 29, 1922, Zool. Inst., Sendai.
E. Kitajima, May 29, 1923, Prof. Ent., Coll. Silk Culture, Uyeda.
A. Toki, April 12, 1923, Tokyo.
Hirowo Ito, June 4, 1924, Zool. Lab., Tokyo Sericult. Coll.
J. Hatori, April 28, 1925, Biol. and Health Officer, Formosa.
R. Kawamura, May 5, 1925, Pathol., Med. Univ., Niigata.
S. Itah, August 12, 1925, Entom., Kyoto Seric. Coll.
K. Monzen, December 7, 1925, Prof. Ent., Coll. Agr. and Forestry, Morioka.
C. Ishikawa, December 16, 1926, Imp. Univ., Tokyo.
N. Yagi, June 22, 1927, Ent. Lab., Kyoto Imp. Univ.
T. Shiraki, June 8, 1928, Taihoku Imp. Univ., Formosa.
T. Esaki, June 22, 1928, Ent. Lab., Kyushu Imp. Univ., Fukuoka.
S. Inomata, October, 1928, Prof. Ent., Coll. of Agr., Tottori.

Finally it became necessary, on discovery of the dangerous work of the so-called Japanese beetle, to send other experts to Japan to search for the parasites of this injurious species. C. P. Clausen and J. L. King were sent over in 1919 and 1920 and a few years later T. R. Gardner was also sent. The story of Japan's perfect courtesy was again repeated. The work of these men was rendered as easy as possible; their studies were greatly aided by the kindness of Japanese colleagues, and their important shipments to this country were facilitated in such a way as could hardly be expected from a foreign people.

In medical entomology, Japan has already done great work. As is widely realized, that country has been keenly appreciative of the value of all discoveries looking towards broad health measures. The early discoveries of Kitisato, which brought him at once into the ranks of the great workers in medicine, were followed by intense activity in all measures relating to public health; and it did not need Major Louis Livingston Seaman's fine book entitled "The True Triumph of Japan," published after the Russo-Japanese War, to fix the attention of all people interested in such questions on the advances Japan had made in health matters.

Medical entomology has kept up with other branches, and much is to be expected from the Japanese workers.

BRITISH INDIA

British East India is larger than Australia. It is almost as large as all of Europe. It is almost as large as the United States. It is a very thickly settled country, with a very great range of climatic conditions, and therefore has a most varied agriculture. But after all it is not a wealthy country. We can see there what over-population would bring to the newer nations of the world such as the United

States or Australia, if the people were not gifted with energy and foresight or if they failed to read the lesson that India should teach them.

With its range of climate, the insect fauna of India is richer than that of Europe or Australia. Entomologists knew this long ago. As early as 1798 Fabricius had described or recorded more than a thousand species of insects from India, and during the next century the English collected and described many additional thousands. Good entomologists of other nations later, like the Frenchmen Amyot and Serville for example, developed the taxonomic side of Indian entomology until the region became famous for its profusion of new and strange forms. Catalogues of different groups of Indian insects were published by Atkinson, Moore, Cotes, Swinhoe, and others. But for a very long time little was known of the biology of the different forms, and practically no attention was paid to the economic importance of entomology.

The Indian Museum at Calcutta, a Government institution, among other things brought together a collection of insects, and as early as 1885 the Director, Wood-Mason, published reports on the tea-bug of Assam and on a pest to the rice plant in Burma. The Museum from that time became the center of information on injurious insects. In 1888 Mr. E. C. Cotes was in charge of the entomological collections of the Museum, and began the publication of an official series entitled "Notes on Economic Entomology." In the early part of that year Mr. Cotes prepared two reports, one on the wheat and rice weevil and the other on insecticides, and he was sent to an agricultural conference at Delhi where arrangements were made by the various provincial governments to send reports and specimens to the Museum from officials concerned with agriculture in all parts of India. The task of collating the results and also of carrying on such investigations as could be conducted at headquarters was entrusted to Mr. Cotes aided by a staff of six office assistants of his own selection. Circular letters were sent out to all parts of the country, and large numbers of reports and specimens soon began to come in. The results were published from time to time and freely circulated. In the next few years the identity of several hundred of the more important injurious species affecting the crops of India was ascertained; the nature of the damage occasioned by them became known, and their life histories in a large number of cases had been traced out. Information had been continuously supplied to officials and planters as to the nature of their insect pests, and the more promising methods of treatment. Many experiments had been tried with a view to the

adaptation of insecticides in use in other parts of the world to the requirements of special crops under cultivation in India. The publication of the Indian Museum Notes was continued for a number of years, and the set is valuable for reference to workers in all parts of the world.¹ Some of the illustrations are wonderfully well done. Five volumes and one part of a sixth were published.

At the expiration of Mr. Cotes' term of service, Mr. Lionel de Niceville was appointed Entomologist to the Government of India. He was instructed to carry his investigations into the field and study crop pests in the actual regions in which they were doing damage. Mr. de Niceville was a well known entomologist and a very competent one, but unfortunately in the same year he contracted malaria and died.

In 1901 E. P. Stebbing was appointed Forest Entomologist to the Government of India, and in 1903 H. Maxwell Lefroy was appointed to fill the post made vacant by De Niceville's death. In the interim, Mr. Stebbing had published a series of circulars on agricultural economic entomology issued by the trustees of the Indian Museum. Between 1903 and 1907 Mr. Lefroy had published a number of entomological memoirs of the Department of Agriculture, and Mr. Stebbing had published certain forest bulletins dealing with tree-boring beetles. In the meantime Mr. E. Ernest Greene had been made Government Entomologist for Ceylon, with headquarters at the Royal Botanic Garden at Peradeniya, a position which he held for a time and during which he published the results of some admirable studies, especially with the Coccidae.

It should be noted here that there was issued in 1902 by the Department of Agriculture of Mysore, a bulletin entitled "Notes on Entomology" by A. Lehman, Official Agricultural Chemist. It contains some general statements about insecticides.

In 1905, Mr. Lefroy was transferred to Pusa, to the Central Research Department of the Agricultural Department, and the title of his post was changed to that of Imperial Entomologist to the Government of India. He was given an assistant in agricultural entomology, and an entomologist was also appointed to deal with disease-carrying insects, and there was another assistant.

In 1912 Mr. Lefroy left India to go to London to become professor of entomology in the University of London. He was succeeded by

¹ While busily engaged at this important work in the Museum, one day Mr. Cotes met a young American woman, a writer, who was on her way around the world—Sarah Jeannette Duncan—and later married her. I think they must have gone back to England to live not long afterwards. At all events, Mrs. Cotes has written one or two charming books about English life since that time.

Mr. T. Bainbrigge Fletcher, who had previously held the post of Government Entomologist in Madras, and since that time the Research Institute has grown, new buildings have been erected, and the entomological department has also grown. At the Third International Congress of Entomology at Zurich in the summer of 1925 Mr. Fletcher was present and gave an illustrated address in which he described in full the condition and the equipment of entomological work, and he has been kind enough to send me the manuscript of his address, which I believe has not been published.

In 1907 a very excellent entomologist, Mr. F. M. Howlet, was connected with the work, and the papers that he published showed him to be a man of very great promise. He wrote part of Lefroy's "Indian Insect Life." During the World War he was in England on leave and he acted as Entomologist to the Hygiene Department of the Royal Army Medical Corps during 1916 and 1917, returning to India the latter part of that year. He died in 1920.

The force of the Entomological Section of the Institute in 1925 consisted of one Imperial Entomologist, one second entomologist, one first assistant, seven assistants, four artists, and also field men, clerks, setters, and a menial staff. Very large collections have been built up, and the work covers every aspect of Indian entomology except forest entomology which is dealt with at Dehra Dun.

Prior to his appointment to the Imperial Bureau of Agricultural Research, Mr. Fletcher had been Government Entomologist to the Agricultural College and Research Institute at Coimbatore, Madras. He was succeeded by Mr. E. Ballard in 1914, but the latter was called to the colors at the outbreak of the war, and during his absence the post was filled by an Indian, Mr. T. V. Ramakrishna Ayyar. Mr. Ballard returned in 1919, leaving Madras in 1922 and being succeeded by Rao Sahib Y. Ramachandra Rao.

Admirable work has also been done in the Punjab by Indian workers, and also in the United Provinces, as well as in other sections. A number of the native workers have taken up entomology and are doing excellently well. Among them may be mentioned Mohammed Afzal Husain, Harnam Dass and C. C. Ghosh.

The subject of forest entomology in India is carried on under the Imperial Forest Research Institute created at Dehra Dun in 1906. Prior to that, however, Mr. E. P. Stebbing prepared a small work on forest insects in 1898 and since then has advanced to be the head of the department. His work entitled "Indian Forest Insects of Economic Importance" is an excellent volume.

In 1911 Dr. A. D. Imms was appointed Forest Zoologist, and made a serious attempt to establish the work on a sound basis. He occupied the post, however, only 16 months, and was succeeded by Mr. C. F. C. Beeson who finally succeeded in getting the staff increased and was given three Divisional Forest Entomologists as well as a Systematic Entomologist. In December, 1920, Dr. M. Cameron was appointed as Systematic Entomologist, and was succeeded in 1923 by Mr. J. C. M. Gardner. The present staff of the branch of Forest Entomology consists of the Chief (Doctor Beeson), the systematic worker (Mr. Gardner), two senior grade assistant entomologists, three junior grade assistant entomologists, 13 field men, setters, insectary keepers, etc., two artists, four clerks, and five servants.

One very interesting feature of the more recent Indian work has been the series of entomological meetings first brought together by Doctor Fletcher at Pusa in 1915. All the entomologists of the independent States, of the planters' associations and others were asked to meet at the Pusa laboratories. At this meeting they went over the list of crop pests of India in systematic order, took each insect at a time and went over its distribution, its food plants, and so on, all persons present taking part in the discussion. No report of the proceedings of this meeting was published. The experiment, however, was so successful that a second meeting was called in 1917, a third in 1919, a fourth in 1921, and a fifth in 1923. The attendance at these congresses has increased, and, of those held since the first, very full reports have been published. The 1917 meeting lasted a week, and the results were published in a volume of 340 pages.

The meeting of 1919 seems to have been particularly important, and its proceedings have been printed in three large volumes which comprise 1,137 pages and 182 plates. The proceedings of the 1921 meeting have been published in a volume of 401 pages with 55 plates, and the fifth meeting is recorded in a volume of 422 pages and 37 plates. These volumes make an extraordinarily fine contribution to economic entomology.

It becomes at once evident to one who has examined these large volumes that much work in applied entomology is done elsewhere than under the auspices of the central Government. As a matter of fact, the agricultural departments of the provinces and of some of the Indian States maintain entomological staffs. Mr. Fletcher pointed out in 1925, at Zurich, that in Madras, the Punjab, and the United Provinces, these staffs comprised a Government Entomologist with assistants. He further stated that in the other provinces there are usually only one or two assistants employed in teaching entomology at the agricultural colleges or in economic work in the field.

Madras stands out first among these provincial governments. In 1904 an entomological assistant to the Government Botanist was appointed. In 1909 two others were added, and they were trained under the Imperial Entomologist of Pusa. In 1912 Mr. Fletcher was appointed as Government Entomologist. He was succeeded in 1913 by Mr. E. Ballard. During the period of the war, when Mr. Ballard went to the fighting line, a native entomologist, Mr. T. V. Ramakrishna Ayyar, was Acting Entomologist. Mr. Ballard returned in 1919, devoting himself for three years to the study of cotton and paddy; and in 1922 he retired, as we have stated in an earlier paragraph. Mr. Ballard's name will occur later in our accounts of work in Egypt and in Australia.

The Punjab Agricultural College was established at Lyallpur in 1909. Previously the Department of Agriculture of the colony had carried on some entomological studies under Mr. Carson, and in 1910 an Entomological Section was established, which in 1919 was composed of an Entomologist, M. Afzal Husain, a Master of Arts from Cambridge University, with two principal assistants, five native research assistants, and a good force of clerical and other assistants.

Good work is also being done in the United Provinces, where an Entomological Section was started in 1921. Instruction is given, and investigations are being carried on, largely with cotton insects.

In Burma an Entomological Assistant to the Department of Agriculture, in the person of Mr. K. D. Shroff, was appointed in 1906 and continued until 1918. With the opening of the Mandalay Agricultural College in 1919, very good plans for entomological work were made, and an excellent worker, in the person of Mr. C. C. Ghosh, was made Entomologist, Research Officer in charge of the Entomological Station and Lecturer on Entomology, a good force of assistants being planned for him. In December, 1930, Mr. Ghosh visited Washington and made a short address before the Entomological Society.

In Mysore, Dr. L. C. Coleman was appointed Entomologist and Mycologist as early as 1907. He was made Director of Agriculture in 1912, and Dr. K. Kunhi Kannan was appointed Entomologist in 1923.

Entomological work has also been done in the provinces of Travancore, Baroda and Hyderabad.

In addition to this provincial work, the Indian Central Cotton Committee has maintained a small laboratory for work on the spotted bollworm of cotton, the Indian Tea Association has on its scientific staff an entomologist (Mr. E. A. Andrews) who for many years

worked on the control of the so-called "mosquito blight" of tea (*Helopeltis*). Moreover, the Bombay Natural History Society publishes in its journal many important papers on the life histories of Indian insects, and the Asiatic Society of Bengal has also published entomological papers in its journal from time to time.

CEYLON

Admirable work against injurious insects had been done in Ceylon for a great many years. Mr. E. Ernest Greene, for many years connected with the wonderful Botanic Gardens at Peradeniya, was an excellent entomologist, and continues his remarkable work on scale insects today although he retired to England many years ago. Ceylon has had a succession of good economic workers. One of the early Carnegie Students, Andrew Rutherford, went out there and published a number of excellent articles, mainly in the journal entitled Agriculture. After his death, E. R. Speyer, another Carnegie Student to America, was sent out, and published several reports. And there are also reports signed by G. M. Henry, Assistant Entomologist. After Mr. Speyer returned to England, J. C. Hutson was appointed Government Entomologist and still holds the office. Mr. F. C. Jepson is Assistant Entomologist, and Mr. C. B. R. King is the Entomologist at the Tea Research Institute. Mr. King was formerly Entomologist to the Empire Cotton Growing Corporation in Nyasaland and Mozambique. Prior to his appointment in Ceylon, Mr. S. S. Light held the post. It should be stated that in 1916 Nigel K. Jardine held the temporary entomological post for the investigation of the tea Tortrix. G. M. Henry, in *Tropical Agriculture* for March, 1917, published a detailed account of this insect.

DUTCH EAST INDIES

Although Holland in Europe is a very small country, her colonial possessions are very great. I remember vividly how the American delegates to the International Congress of Entomology and Phytopathology at Wageningen in 1923 were impressed when one of the Dutch delegates showed a map of Holland and its colonial possessions superimposed upon a map of the United States. None of us had realized down to that time that Holland with its colonies covers a territory which would compare favorably with the whole of the most fertile portion of the United States proper.

The Dutch have shown themselves to be wonderfully good colonizers, or, perhaps better, administrators of colonies. Their East Indies possessions, situated as they are in the tropics, offer a very

marked contrast to Holland. The native peoples as a whole would have been very difficult to govern harmoniously, to any other people but the Dutch. The great islands of Java and Sumatra are extremely fertile and grow crops of enormous value—sugar, tobacco, coffee, tea, cinchona, rubber, and others of lesser value. The Dutch have had to learn to know the people of these islands, and to cultivate these extremely valuable crops in the most productive manner. They have made a very thorough study of these matters; they have for generations sent many of Holland's brightest minds to the East Indies to take administrative or technical positions, and the results have been extraordinary from the view-point of applied agriculture as well as of social administration. It is rarely, in fact, that one speaks to a Hollander in a higher position at home who has not served his term in the East Indies.

In 1896, Dr. L. Zehntner, an entomological expert, began to publish in Java, and he soon began correspondence with the entomological service in Washington, largely in regard to the identity of some of the insects that he was encountering in his economic work. He was obviously a well trained entomologist and quite competent to make careful biological and taxonomic studies of his new material. Many of the pests he encountered were new to science, and he described new species among them in the Coccidae, in the Aphididae, in the parasitic Hymenoptera, and in other groups. Situated as he was, far from the large collections and far from libraries, it is remarkable to see how well his work was done. He was either a very good and careful artist himself or he had the services of one. And evidently his fund for illustrations was not small, because his bulletins for the next ten years were illustrated with colored plates of a rare excellence. He made some mistakes in the placing of some of his new insects, but this is easily forgiven when we remember that he was working in Java. With his *Parasitica*, his early work showed a much better understanding of the subject than did, for example, the comparable work of Juan Brèthes in South America who in a similar way began to publish about parasitic Hymenoptera without a full library and without competent collections for comparisons.

L. P. de Bussy, a well trained zoologist, was sent out to Sumatra and was made Economic Zoologist of the Tobacco Planters' Experiment Station at Deli. A wide-spread insect, *Heliothis obsoleta*, known in the United States as an enemy to corn, tomato, cotton, tobacco, and certain other crops and which is here variously known as the cotton bollworm, the corn earworm and the tomato fruit-worm, was found to be damaging the Sumatran tobacco rather seriously. Doctor

de Bussy, knowing of the occurrence of the insect in this country and understanding that it was not a serious pest of tobacco here, thought that it might be held in check here by parasites that could be introduced into Sumatra; and the tobacco planters adopted a suggestion that he should go to the United States to secure such parasites. This decision was reached rather suddenly in the late spring or early summer of 1910, and he started for the United States via Amsterdam. The Dutch Government took the matter very seriously and notified the Dutch Minister to the United States that Doctor de Bussy was on his way, and asked him to lighten his path officially. As it happened, at that time the Dutch Minister was Jonkeer Loudon, long afterwards Minister of Education in Holland and one of her foremost statesmen. The Minister and his family had gone to Bar Harbor for the summer, but he left that cool summer resort on receipt of the advices from his home government and came to Washington in the heat of July to assure himself that the expert from Sumatra would be properly received. I assured the Minister that we would do our utmost to forward the purpose of the mission, and at the same time was very much impressed by the importance of the matter as evidenced by Mr. Loudon's unusual action. De Bussy proved to be a delightful and able man, and I went with him to the Pacific Coast and back through the Southwest to Texas where I left him with Doctor Hunter and his assistants at Dallas. The *Heliothis* was very abundant in Texas, and the *Trichogramma* egg-parasite was also abundant. De Bussy engaged one of Doctor Hunter's assistants to make shipments of parasitized eggs to Sumatra, and returned to his post.

Living parasites were introduced, but I believe brought about no especial change of conditions in the tobacco fields. I feel rather sure that the same species of *Trichogramma*, or one closely related to it, must have been present already on the island, or at least in Java, since it is figured on one of Zehntner's plates. The anecdote is told to show the thought given to the subject by the planters and their experts and to indicate their enterprise.

As a matter of fact, the *Heliothis* is by no means controlled by its parasites in the United States, and the comparative immunity of tobacco from its attack is probably due to the very great abundance of preferred foods, such as corn, tomatoes, or cotton.

As would be expected from the personnel, the publications coming from the Dutch East Indies have been of the highest character, not only in other aspects of agricultural science but also in economic entomology.

The Experiment Station for East Java was apparently founded in 1887, principally for sugar investigations. At the same time sta-

tions were started in West Java and Middle Java. Each station seems to have had its independent series of publications.

In the first volume of the East Java station was published a long account of a Scarabaeid beetle (*Apogonia destructor*) with three excellent engraved plates. The author was J. D. Kobus. It was published separately as No. 28 of the first series. In No. 43 of the same series the same author published an article on the same insect, and in this article described *Thrips striatoptera*, with an engraved plate.

The Experiment Station at Medan, Sumatra, seems to have made a specialty of tobacco more than any other crop, and it published a series of bulletins brought together in volumes from October, 1906, to 1924. In the earlier volumes are articles by L. P. de Bussy and others on insecticides and on the insect plagues of tobacco. As elsewhere stated, Doctor de Bussy came to the United States in 1910, and on his return published several papers. In 1916 he published a paper on the cigaret-beetle. In that year J. E. A. Van Doop published an article on the spread of the *Trichogramma* introduced into Sumatra from America by De Bussy; and in 1918 the same writer published on the tobacco louse and other tobacco insects.

In 1907 the West Java station was amalgamated with the station for East Java, and later publications were issued by Dr. R. Fulmek and Dr. H. H. Karny.

For the past 13 years Dr. S. Leefmans and Dr. P. van der Goot have been publishing entomological articles under the Institute for Plant Diseases at Buitenzorg. These have appeared as a rule in the form of bulletins, and refer largely to sugar cane insects. Later important papers on the rice borer, on the pests of cinchona, on a borer in the stems of jute, on the coffee borer, on tea insects and those injuring cocoa, and so on, have been published by these writers and also by L. G. E. Kalshoven, W. C. van Heurn, and W. Roepke.

We have already mentioned Dr. L. Zehntner. He began publishing at an early date in the Archives of the Java Sugar Industry and in the Proceedings of the West Java Sugar Station. Many of his articles were very important. Dr. W. Roepke in 1911 and 1912 published four papers on cacao insects.

Thus very good men, trained in biology as applied to agriculture, have been working at various problems at these Dutch East India stations for many years, and their work has given these stations very high rank in the scientific world. They have included workers in plant diseases as well as entomologists, plant physiologists, and other specialists. Of the entomologists, L. P. de Bussy, K. W. Dammerman, W. Roepke, S. Leefmans, and P. van der Goot have all visited

Washington, and I am able to write of them in the highest terms, not only professionally but personally. No other country has a more competently manned service in economic entomology.

Notable for its size and completeness is the large work entitled (translated) "The Agricultural Zoology of the Malay Archipelago," by K. W. Dammerman, Zoologist to the Department of Agriculture at Buitenzorg, Java, published in Amsterdam in 1919. This is a volume of 368 pages, illustrated by 39 plates and 134 text figures. A number of the plates are colored and are extremely well done. While the work includes the whole of agricultural zoology, it is almost entirely entomological and pays especial attention to remedies. It is a very well printed royal octavo, issued from Amsterdam.

By the close of 1927 Doctor Dammerman had prepared an English edition of this work. The scope of the work was extended to neighboring countries with faunas almost identical with that of the Dutch East Indies so far as pests are concerned, and he includes facts placed at his disposal by Prof. C. F. Baker of the Philippines and Mr. G. H. Corbett of the Federated Malay States. The book was considerably enlarged, and in its English form covers 473 pages. It was published at Amsterdam in 1929. It is interesting to note that, although Dammerman speaks very good English, he nevertheless submitted the entire manuscript to Capt. H. S. Bushell, Assistant Editor of the Review of Applied Entomology, for the purpose of having the English corrected and the whole manuscript put into shape "according to the English practice of printing."

Aside from those already mentioned there have been other good investigators and writers among whom should be mentioned especially P. E. Kuchenius, C. J. J. van Hall, A. E. Rutgers, and M. Ishida. Rutgers has published some very good reports for the Association of Rubber Planters of the east coast of Sumatra.

Dr. Oswald Schreiner, of the United States Department of Agriculture, who attended the Pan Pacific Science Congress in Java in 1929, has lent me an elaborate book entitled "Science in the Netherlands' East Indies," from which I am able to straighten out my conception of the organization of the different stations carrying on work in economic entomology in the Dutch East Indies. In the first place there is a Department of Agriculture, Commerce, and Industry, and this Department has among its technical divisions an Institute for Plant Diseases, which includes of course economic entomology. This technical division devotes itself to the estate crops (in close collaboration with private experiment stations) and to native agriculture. And then there are a number of private experiment stations, the costs

of which are borne by the large estates. For example, there is the experiment station for the Java sugar industry at Pasuruan, two tobacco stations (one at Klaten and one at Medan), two rubber planters' stations (one at Medan and the other at Buitenzorg), a tea experiment station at Buitenzorg, a cinchona station at Pengalengan, a coffee station at Malang, and several others that cover more than one type of culture.

The "Conspectus of Institutions of Pure and Applied Science in or Concerning the Netherlands' East Indies" contains a formidable list of institutes, laboratories, experiment stations, surveys, and observatories. Under the head of private experiment stations for the agricultural sciences, there are listed six for West Java, three for Central Java, three for East Java, and four for Sumatra (east coast). It is safe to say that more or less sound work in economic entomology has been done at nearly all of these stations, partly under the direction of the central Department of Agriculture and partly by an occasionally employed expert, all at the expense of planters' associations. There is, moreover, an Association of Government Agriculturists in the Netherlands' Indies, and also an Association of Experiment Stations' Personnel.

I had been relying on Dr. W. Roepke, now of Wageningen, for exact information regarding the Dutch East Indies, but, unfortunately for my purpose, Doctor Roepke was absent from Holland during 1929 and was unable to comply with my request until May, 1930, when he had returned and naturally was overwhelmed with other work. So I wrote what precedes. Now, at the last moment before this goes to the printer, I have received a four-page manuscript from Doctor Roepke, accompanied by a list of 25 writers on one or another aspect of the insect problem in the Dutch East Indies. I believe that it will be best to abstract Doctor Roepke's report in the interest of exactitude, as follows:

Both the Government and private research laboratories have done and are doing research in applied entomology. The Botanical Garden in Buitenzorg, established in 1817, employed Dr. C. J. J. Koningsberger, of Utrecht, as Zoologist and Entomologist about 1895. He worked on the insect pests of various tropical crops, especially coffee. Doctor Zimmerman (a German), the Botanist of the Station, worked with him, especially on thrips and insects injurious to rubber plants. Doctor Koningsberger became later the Director of the Zoological Museum and Botanical Garden in Buitenzorg, and later Minister of the Dutch Colonies (in 1925), retiring in 1929.

Applied entomology started really in 1905, after the Department of Agriculture was established in Treub, and in 1910 a Phytopathological Institute was started in Buitenzorg and placed in charge of Dr. C. J. J. van Hall. The first Entomologist was Dr. W. Dammerman, who was later assisted by Dr. S. Leefmans and somewhat later by L. G. E. Kalshoven, W. C. van Heurn, W. Roepke (temporarily), and P. van der Goot. Dr. N. Kemner, of Stockholm, was temporarily employed as an entomologist. Doctor Dammerman became Director of the Zoological Museum after the World War. Doctor Leefmans is at present the Director, and the entomologists are Van der Goot, Kalshoven, Reyne (formerly in Surinam), Van der Vecht, Voute, Dr. C. Franssen, and a few European assistants. The Government in 1909 appointed the neuropterologist, H. W. van der Weele, as Entomologist for the Cinchona Plantation at Tjinieroean, but he died a year later in Java of cholera. Dr. H. H. Karny, of Vienna, worked as an entomologist in the Zoological Museum from 1920 to 1929. He was succeeded by Lieftinck, of Amsterdam.

In the veterinary service and the medical service several good medical entomologists have been employed, namely Schuurmans Stekhoven, Schüffner, Swellengrebel, Rodenwald, Van der Brug and E. W. Walch.

Private research laboratories for the larger plantations began work in economic entomology before the Government. The Sugar Cane Laboratory was established in Kagok, West Java, in the late eighties, but later was transferred to Pasoeroean, East Java. Kobus and Krüger published their first papers on sugar cane insects late in the eighties or early in the nineties. Then Zehntner began his classical work which was summarized later by W. van Deventer. Van der Goot worked as an entomologist at this institution in 1913 and 1914. Then entomological work was discontinued for 14 years when it was taken up once more by Dr. Hazelhoff, of Utrecht.

Dr. L. Zehntner was a Swiss. He left the Sugar Cane Research Institute in 1900 and took charge of a small cacao experiment station in Salatiga. He resigned from this position in 1906, and went to Brazil [I understand that he has returned to his native Switzerland and is now living near Basel]. Doctor Hunger, of Amsterdam, succeeded him in the sugar cane station and was assisted by Doctors van Leeuwen and Roepke as entomologists, the former in Salatiga and the latter in Bandoeng where he was especially engaged in cinchona investigations. Prior to 1928 Miss Wilbrink (Cheribon) did some entomological work. Doctor van Leeuwen resigned from the experiment station and was succeeded by Doctor Roepke. The for-

mer became a teacher for a time, and in 1918 became Director of the Botanical Garden in Buitenzorg. In 1911 Doctor Roepke took charge of the experiment station in Salatiga. In 1914 Dr. P. van der Goot became his assistant and served until 1917. Doctor Roepke resigned his position in 1918, on account of his health, but worked in Buitenzorg until 1919 at the Phytopathological Institute. Later he accepted a position as Professor of Tropical Agriculture in Wageningen, and still later became Professor of Entomology there.

The Tobacco Planters' Experiment Station at Deli did perhaps more entomological work than the other stations. L. P. de Bussy was the first Entomologist and served from 1907 to 1917. Later he entered the service of the Colonial Institute in Amsterdam and also became professor in Utrecht where he gives lectures on tropical agriculture. J. den Doop, C. J. van der Meer Mohr and Doctor Fulmek also did some entomological work at Deli.

Dr. J. D. Corporaal for a few years worked as Entomologist to the Rubber Experiment Station in Medan and is at present Curator in the Zoological Museum at Amsterdam.

The Tea Experiment Station at Buitenzorg did much entomological work. Dr. R. Menzel, a Swiss, worked as Entomologist from 1918 to 1928. He returned to Switzerland and is at present Director of the Experiment Station for Fruit and Vine Culture in Wädenswyl.

H. Jensen, a Dane, also worked on tobacco insects in Java until about 1917, and the botanists Wurth and P. Arens did some work on entomology while at the Coffee Experiment Station in Malang. Dr. H. Begeman, of Utrecht, was appointed Entomologist at this Station and worked from 1925 to 1929 exclusively on coffee insects. He was succeeded by Dr. J. G. Betrem, of Wageningen, an assistant to Doctor Roepke.

During the war, *Stephanoderes hampei* became a great coffee pest. It had been noticed in West Java as early as 1909, but did not become prominent until a number of years later. In 1922 the coffee planters established a fund and sent J. den Doop to Uganda to search for parasites. He introduced two—the one a Braconid (*Heterospilus coffeicola* Schniedeknecht) and the other a Chalcidid (*Prorops nasuta* Waterston). The latter species met with some slight success, but so far has not checked the pest. In 1922 Dr. K. Friederichs, the German entomologist, who had worked in Samoa, took charge of the coffee-beetle work and remained in Malang until 1924 when he returned to Germany [where he has done the excellent work at Rostock mentioned elsewhere].

Doctor Roepke has also sent me references to the publications of the different men mentioned above, but it will be unnecessary to print the list here.

MALAYA

The first Government Entomologist in Malaya was Mr. H. C. Pratt. He was appointed in 1906, and held the title of Government Entomologist at the Institute for Medical Research, Kuala Lumpur, in 1907. He was transferred to the staff of the Director of Agriculture in 1908, and continued in that post until 1916. His especial publications related to *Artona catoxantha* Hampson, a pest of coconuts, to the termite (*Coptotermes gestroi* Wasm.) that damages rubber, and to the migratory locust. He also published occasional articles on insecticides in the Agricultural Bulletin of the Federated Malay States. In 1911 Mr. C. B. Holman-Hunt was appointed Assistant Entomologist, and the title was changed to Systematic Entomologist in 1919. He retired from that post, for age, in 1920, the vacancy being filled by the appointment of Mr. H. M. Pendlebury. In 1913 Mr. P. B. Richards was appointed an Assistant Entomologist. In 1916 Mr. Pratt resigned, and Mr. Richards took the place of Government Entomologist, which he held until 1920. Mr. Richards paid especial attention to the white ant, and I am informed that his recommendations for the control of this insect are still practiced on all estates.

Mr. G. H. Corbett, who in 1911 was connected with the Royal Agricultural College at Cirencester, England, came to the United States of America in 1914 as a Carnegie Student. He remained here for about a year and then returned to England where he obtained a commission in the Royal Field Artillery and served in France until June, 1917, when he was seconded to the Egyptian army for service in the Sudan, returning to England in the autumn of 1919. In 1920 he was appointed Government Entomologist in Malaya to succeed Mr. Richards. Dr. Guy A. K. Marshall informs me that from 1922 to 1924 Mr. Corbett worked single-handed. I note, however, that in 1923 H. W. Jack published about the insects affecting rice in Malaya—both growing rice and stored rice, the stored rice enemies being, of course, the ordinary cosmopolitan species. Mr. Corbett has a long list of papers to his credit relating to the different injurious insects of Malaya. Mr. B. A. R. Gater was appointed Assistant Entomologist in 1924, and in 1925 published an article entitled "Some Observations on the Malaysian Coconut Zygaenid (*Artona catoxantha*)."

This paper called attention to an insect that came to have a roundabout importance, since it was a Tachinid enemy of this moth

that was introduced later into Fiji with such success against the Levuana caterpillar. He also published other papers, either independently or in collaboration with Mr. Corbett. In 1926 he resigned to take up the post of Malaria Research Officer in the Institute of Agricultural Research. In 1928 Mr. H. T. Pagden and Mr. N. C. E. Miller were appointed assistant entomologists. Mr. Pagden has been engaged in investigating three stem borers of paddy. Mr. Miller had been working for two and a half years with the Tsetse Research Branch, Game Preservation Department, in Tanganyika Territory. He is especially interested in the Acridiidae.

Mr. Corbett and his force have been doing very good work, and have published a number of admirable reports and articles. One of Mr. Corbett's interesting articles, published in 1920 in collaboration with D. Ponniah, related to an alleged damage done by insects to rubber seed. A publication entitled "Gardens-Bulletin Straits Settlements" has published some good articles by E. Matthieu and by F. Flippance.

PALESTINE

True economic entomology in this country was taken up after the conquest in 1917-18 by British forces. As a State under British mandate, with a civil administration under a British High Commissioner, affairs are carried on as in many other parts of the British Empire.

From May, 1921, to August, 1923, Dr. P. A. Buxton was Medical Entomologist to the Government, and he made a lengthy report entitled "Applied Entomology of Palestine" which was published in the Bulletin of Entomological Research for March, 1924. The bulk of this report was devoted to entomological matters of medical or veterinary interest, but some attention was given to agricultural pests.

In 1923 Mr. G. E. Bodkin, who had held important official positions in British Guiana and who had devoted much time to the economic entomology of that colony, went to Palestine, having received appointment as Government Entomologist. He began important investigations at once. One of his earlier tasks was to introduce the fumigation of citrus trees into Palestine. This work he began immediately, and published in 1925, in the Bulletin of Entomological Research, the results reached down to that time. In 1927 he published in the same journal an important article on the fig wax scale (*Ceroplastes rusci* L.). In 1928 there was a locust invasion of Palestine, and the Bulletin of Entomological Research for August, 1929, contains a very important article with maps and illustrations concerning this invasion. The locust invasion was repeated in 1929, and Mr. Bodkin wrote a

leaflet published as No. 8 of Series I of the Agricultural Leaflets issued by the Government of Palestine.

In the meantime he published in the *Bulletin of Entomological Research* a short but important article called "A Note on the Utility of Aerial Photography in Entomological Field Work." He had found, in his efforts to wipe out certain scale insects on Citrus trees, that it was often very difficult to locate Citrus trees in different gardens. From the airplane, however, these trees were readily located and mapped for an entire district. This, by the way, is the same service that the airplane did for the United States Department of Agriculture in its efforts to locate hidden cotton fields in clearings in the woods at a time when a search was being made for possible infestations by the pink bollworm.

In 1923, Dr. F. S. Bodenheimer reported, in the *Bulletin of the Royal Entomological Society of Egypt*, on scale insects from El-Arish (Sinai) and Transjordan, and the next year he was appointed Entomologist to the Zionist Organization Agricultural Experiment Station, publishing his first bulletin in July of 1924. It was entitled "The Coccidae of Palestine." During the same year he published a leaflet on the leopard moth, and others on the clothes moths and upon general measures against insect pests in field and garden. I had the pleasure of meeting him at the International Zoological Congress in Budapest in 1927, where he read a strikingly interesting paper on the so-called "manna" of the Children of Israel in the desert. I have previously referred to Doctor Bodenheimer's remarkable two-volume work published recently in Berlin on (translated) "Material for the History of Entomology before Linné." Doctor Bodenheimer is now connected with the Hebrew University at Jerusalem. He is obviously a man of training and culture.

Some very notable work in medical entomology has been done in Palestine since the World War, especially in the way of relief from malaria, a disease which seems to have held the people of Palestine in subjection for hundreds of years. This excellent work is described and summarized in a just-published book entitled "The Epidemiology and Control of Malaria in Palestine" by Israel J. Kligler, Director, Department of Hygiene, Hebrew University, Jerusalem (University of Chicago Press, 1930).

PART IV

AFRICA



EGYPT

At the Fourth International Congress of Entomology at Ithaca, New York, August, 1928, an interesting paper was read entitled "The Development of Entomological Science in Egypt," by H. C. Efflatoun, Bey, at that time Director of Research in the Plant Protection Department of the Ministry of Agriculture of Cairo. Many of the facts related in the following paragraphs are based upon portions of that address, which, however, related to all entomological science, including applied entomology.

Civilization in Egypt is very ancient, and a hieroglyphic honeybee is found on a sarcophagus dating back to 3633 B. C. It is supposed to represent a king of lower Egypt. Another well known Egyptian hieroglyph is that of the sacred dung-beetle (*Scarabaeus sacer*) ; and Mr. Efflatoun states that an excellent carving of a locust, that he thinks may be *Schistocerca gregaria*, has been found on the walls of a tomb at Thebes of the date of Rameses, 1400 B. C. Probably the first detailed reference to a great locust invasion is that given in the Old Testament (Exodus 10, 13-15). Mr. Efflatoun points out "that this Biblical description of the locust plague that Moses engineered on behalf of the Lord" is remarkable in its reference to the direction of the wind, since it corresponds exactly with the east winds that were prevalent during all the locust invasions of Egypt in the last century. Lice and flies are mentioned in the Biblical account of the plagues of Egypt. "Worms" are mentioned on one or more of the ancient papyri. It is stated by several authorities that these creatures were larvae of *Agrotis ypsilon*, the familiar cutworm of the Egypt of today. A paragraph is quoted that reads, "The worm ate half the crop and the hippopotami ate the other half. The fields were full of rats, a swarm of locusts settled down and fed, the sheep also ate and the birds stole." Another papyrus in hieroglyphics is stated by Mr. Efflatoun to have been identified as a royal decree in which the director of the administration of agriculture reminds the farmers of the fact that "the worm" ate a large portion of the crop and that this was due to their negligence in dealing with it. Furthermore, he exhorted them to do their best that year to check it, kill it and thus reduce its harm. It is a pity that the director did not tell the farmers how to check it and how to kill it, since we would then have had in this papyrus the first distinctive writing on practical entomology!

Of course the oft quoted lamentations of Joel give other instances of insect damage in old Egypt.

Mr. Efflatoun points out the influence of Mohammed Ali Pacha (1805-1848) in the renewal of the national spirit of Egypt and in the introduction of cotton which found the Valley of the Nile enormously favorable to the crop. Agricultural methods and customs, however, changed little, and in fact have changed but little down to the present time. To the Egyptian peasant and farmer "an insect represented a manifestation of strength, which, at one time was regarded as divine in origin and at another as of obscure origin—but at all times badly defined and regarded as inevitable." (Efflatoun.)

The Khedivial Agricultural Society was founded in 1898 by Sultan Hussein Kamil, and it was this Society which recognized the necessity of protecting cotton and of the selection and distribution of cotton seed. This Society as well as the higher School of Agriculture undertook advisory work in general agriculture before the actual existence of a Ministry.

In 1911 the Ministry of Agriculture came into existence and immediately established an Entomological Section to which Dr. L. H. Gough was appointed Entomologist. Prior to this time (in 1907) the Entomological Society of Egypt was founded, which grew slowly but which now is an important scientific society.

In 1913 Doctor Gough was given two assistants, and the branch grew in importance.

The present King of Egypt (Fuad I) became Sultan in 1917 and was proclaimed King on March 16, 1922. Down to this time the principal officers in the entomological service had been English, but the present King showed himself greatly interested in scientific matters, generously supporting the scientific institutions already existing as well as inciting much important work. A number of young Egyptians of high intelligence have gone to England and to the United States to study, and several of them are now in important positions in the service. I am indebted to Mr. Efflatoun for the tabulated statement that follows regarding the foreign and the native officials in the Entomological Division of the Plant Protection Section of the Ministry.

FOREIGN OFFICIALS OF THE ENTOMOLOGICAL DIVISION, PLANT PROTECTION
SECTION, MINISTRY OF AGRICULTURE, EGYPT

Name	Term of Service	Remarks
L. H. Gough, Ph.D.	August 1911 to June 1923	Now in South Africa
G. Storey, B.A. (Cantab.)	1913 to 1920	Died in 1920
E. W. Adair, B.A.	July 1914 to April 1924	Was transferred to Ministry of Education
Fred Shaw, A.R.C.Sc. (Director Administration)	1916 to present	

Name	Term of Service	Remarks
W. J. Hall, A.R.C.Sc., Ph.D.	December 1919 to Nov- ember 1926	Now with British South Africa Co., Mazoe
E. Hargreaves, A.R.C.Sc.	February 1921 to April 1923	Now in Sierra Leone
T. W. Kirkpatrick, M.A.	June 1921 to July 1925	Now in Kenya Colony
Adolf Andrès (Collec- tions)	February 1926 to present	
J. E. M. Mellor, M.A. (Beekeeping and vari- ous)	May 1926 to present	
E. Ballard, B.A., Director General, Plant Protec- tion Section	March 1928 to present	
Evan Nel, D.I.C., M.Sc. (Fruit-fly investiga- tions)	December 1928 to present	
H. Priesner, Ph.D.	November 1928 to present	
C. B. Williams, M.A.	June 1921 to July 1927	Now in Edinburgh
A. Alfiéri (formerly in charge of the collec- tions)	1924 to 1929	Actually General Secre- tary and Curator of the Royal Entomological Society of Egypt

EGYPTIAN TECHNICAL OFFICIALS OF THE ENTOMOLOGICAL DIVISION, PLANT
PROTECTION SECTION, MINISTRY OF AGRICULTURE, EGYPT

Name	Term of Service	Remarks
Naguib Iscandar, C.A. (Fumigation)	January 1912 to February 1928	Died in February 1928
Wadie Sharobim, Eff. (Silkworms)	1927 to present	
Abdul Megid El Misti- kawi, Eff. (Locust in- vestigations)	1915 to present	
Mohd. Soliman El Zo- heiry, A.R.C.Sc., D.I.C. (London) (Locust in- vestigations)	1920 to present	
Mohd. Kamal, Ph.D. (University of Califor- nia) (Parasites)	1920 to present	
Rizk Atia, A.R.C.Sc., B.Sc., D.I.C. (London) (Granary)	1927 to present	
Ibrahim Bishara, Eff. (Cutworm)	1918 to present	
H. C. Efflatoun, Bey, M.S.E.A.C. Hon. Ent., M.R.A.C. (Formerly Director for Research)	December 1923 to October 1929	Transferred to the Egyp- tian Univ., Abbassiah, Cairo, and actually oc- cupying the post of Asst. Professor of Zo- ology

A large number of valuable papers have been put out by the Ministry of Agriculture in several series. An Agricultural Journal of Egypt was published from 1911 to 1920, and in 1923 a new series was started monthly printed in Arabic only. A New Annual Series in English was started in 1923 and continued for two years, when it was stopped.

A series of technical and scientific bulletins was begun in 1916. Eighty-five numbers were published down to 1928, of which 33 were concerned with economic entomology. These technical bulletins, whose authors included Messrs. Storey, Gough, Williams, Bishara, Iscandar, Hall, and Mellor, cover a large field.

There is, in addition, a short series of entomological pamphlets and a long series of Agricultural Circulars. Of 99 of these, beginning with March, 1911, and continuing until December, 1925, 27 are concerned with economic entomology.

In addition to these publications, members of the scientific staff have published occasional articles in the Bulletin of Entomological Research in England.

Doctor Gough, who was head of the service for so many years, was concerned mainly in matters of administration but published some sound papers on the life history of the pink bollworm and on its dispersion in Egypt. He also published an important key to the identifications of the scorpions of Egypt.

Mr. Storey seems to have occupied himself principally in regard to control measures for the pink bollworm and published papers on the treatment of cotton seed and a general paper (in 1921) entitled "The Present Situation with Regard to the Control of the Pink Bollworm in Egypt."

Doctor Hall, during his seven years residence, seems to have worked principally with scale insects. He published as one of his first papers an account of the hibiscus mealy-bug, and in 1924 issued a paper on the insect pests of Citrus trees in Egypt. In 1925 he published notes on Egyptian Coccidae with descriptions of new species, and in 1926 a paper entitled "A Contribution to the Knowledge of the Coccidae of Egypt." The same year there were published over his name two pamphlets, the one relating to the hibiscus mealy-bug with notes on the introduction of *Cryptolaemus montrouzieri* and the other one notes on the Aphididae of Egypt.

Mr. Kirkpatrick published one ornithological paper and a large and important work entitled "The Mosquitoes of Egypt" which was done under the auspices of the Antimalaria Commission. It was a large work of more than 200 pages, fully illustrated with figures and maps.

He also published another bulletin on the relations of the fungus, *Rhizopus nigricans*, to the insect pests of the cotton plant in Egypt.

Mr. C. B. Williams, who had been studying in the United States and had held the post of Sugar Cane Entomologist under the Department of Agriculture of Trinidad from 1916 to 1921, was in Egypt from 1921 to 1927, first as Subdirector and afterwards as Director of the Entomological Section. From 1927 to 1929 he was Entomologist of the East African Agricultural Research Station in Tanganyika, and is now Lecturer in Agricultural and Forest Zoology at the University of Edinburgh, succeeding R. Stewart MacDougal. During his stay in Egypt, Mr. Williams was very productive. He published in three papers the results of bioclimatic observations in the Egyptian desert. He also published another paper on cotton growing in relation to the climate in Egypt and the Sudan, and two others relating specifically to the pink bollworm. He also published extensively in the Bulletin of Entomological Research and elsewhere on migrations of insects and upon other entomological topics.

Of the Egyptian technical officials, Mr. Ibrahim Bishara has published a paper on the estimation of loss by bollworms, and Mr. Neguib Iscander an interesting report on a mission to California to study new methods of fumigation of Citrus trees. Mr. Iscander visited the Bureau of Entomology in Washington and traveled rather extensively in the United States. Messrs. Soliman and Kamal have both studied at the University of California, and Mr. Efflatoun visited Washington at the time of the Fourth Congress of Entomology in 1928.

Mr. E. Ballard at present has the title of Chief Plant Pathologist and writes me from Giza, Egypt. I am indebted to him for much information and many pamphlets.

SOUTH AFRICA

Work in economic entomology was not established in South Africa until its importance was forced upon the governments of the different States. The Agricultural Journal, which was the official organ of the Department of Agriculture of the Cape Colony, began in the early 1890's to pay much attention to the subject. The so-called Australian bug (*Icerya purchasi*), known in the United States as the white or fluted scale, the grapevine Phylloxera and injurious grasshoppers aroused the colonists to the necessity for more or less investigation, and the Agricultural Department began to open its eyes to these needs. It was some years, however, before an official entomologist was appointed. Mr. S. D. Bairstow and other colonists made certain investigations and corresponded regularly with Miss Eleanor A.

Ormerod, the Honorary Consulting Entomologist to the Royal Agricultural Society of Great Britain, and this correspondence resulted in the publication of a little book by Miss Ormerod entitled "Notes and Descriptions of a Few Injurious Farm and Fruit Insects of South Africa." This book was published in 1889.

A very competent entomologist, Mr. Louis Peringuey, was connected at that time with the South African Museum in Cape Town and was employed by the Department of Agriculture as Entomological Adviser; but in these advisory functions he chiefly answered correspondence, giving the names of the insects and the best remedies known. Acting upon his advice, the Government attempted to stamp out the grapevine *Phylloxera* by means of the bisulphide of carbon treatment, but without success, and he resigned his office in 1893. During this period the Director of the Botanic Garden at Cape Town, Prof. P. MacOwan, also answered entomological questions for the Government. Although an entomologist, he was a man of very wide information, and his communications, most of them subsequently published in the *Agricultural Journal*, showed him to be a clear-headed, practical man.

In 1893 the Department of Agriculture fully made up its mind that it needed a good man at a livable salary to organize and carry on sound work against insects. Knowing the advances that had been made in the United States, they asked the Secretary for the Colonies in London to correspond with me and to secure the best man possible from this country. I approached several well known workers in the United States, among them F. M. Webster and M. V. Slingerland, and also James Fletcher in Canada. But the compensation offered was not great enough to make the change desirable. I then looked for a younger man whose financial needs were not so great, and was very fortunate in finding C. P. Lounsbury, at that time graduate student and instructor at the Massachusetts Agricultural College. He was warmly recommended by Professor Fernald, and when I met him by appointment in New York City, he appeared to have a well trained mind and pleasing personality and the proper amount of energy and ambition. I therefore recommended him to the Secretary for the Colonies, and he took his post in Cape Town in 1895. Lounsbury's work was excellent from the start, and he began at once to conduct investigations of high value to the Colony and in fact to the whole of South Africa. Governmental confidence in his ability was early shown, and he was given ample assistance. He brought about legislative action providing for nursery inspection and restriction on the transportation of plants. Large sums were appropriated for locust

destruction, and, among other things, he investigated the South African ticks that carry diseases of domestic animals.

Two other South African colonies, namely Natal and Transvaal, soon started work in this direction. Claude Fuller (brought from Australia, where he had done excellent work) was placed in charge of the work in Natal, and C. B. Simpson of the United States Bureau of Entomology was sent out to take charge of the new work in the new colony of the Transvaal. Fuller was an excellent man, and has remained with the service all these years. (He died in late 1928 as a result of an automobile accident.) He was not given good laboratory facilities for a long time, but the work that he turned out was sound and established an excellent reputation. Simpson did admirably from the start. He took hold of the existing problems with energy, enthusiasm, and tact. He secured the confidence of the people at once. He conducted investigations on the ordinary crop pests, upon the malarial mosquitoes, and was finally given a large sum, amounting to \$60,000. for locust destruction. His death from typhoid fever, which occurred in the autumn of 1906, was a great loss to the Transvaal and a great loss to economic entomology. He was succeeded by C. P. Hardenberg, also from the United States Bureau of Entomology. Later, W. Moore was made Entomologist at the Potchefstroom School in the Transvaal, C. P. van der Merve was made Government Entomologist and Horticulturist for the Orange Free State, and C. W. Mally, also from the United States, was made Government Entomologist for the eastern part of Cape Colony. Lounsbury remained Government Entomologist for Cape Colony, and was the only entomologist located at a seaport. After a time he got an entomologist with an assistant stationed at each of the four principal ports; each school got an entomologist, and four of them assistant entomologists as well, and a considerable staff was built up at headquarters and for temporary stations.

From the very beginning, Lounsbury had great plans, which however were slow in materializing. In 1910 the four colonies of Transvaal, Natal, Orange River, and Cape of Good Hope were united to form the Union of South Africa. The Departments of Agriculture of the several former colonies were dissolved, and from the released personnel was formed the Union Department of Agriculture with headquarters at Pretoria. The colleges of the Union were brought into cooperation, and the work went forward.

At the time of Professor Lounsbury's retirement, in 1926 or 1927, 25 good men were connected with his organization and properly placed at different points. In addition, four other good men were

stationed with Transvaal University, the University of Stellenbosch, with the Division of Veterinary Research in Pretoria, and with the Institute for Medical Research in Johannesburg. These men, J. C. Faure, C. K. Brain, G. H. A. Bedford and Alexander Ingram, have all been doing excellent work and have been publishing important papers.

A number of these 25 assistants published good original work. I notice, for example, that D. Gunn was the author of four publications in 1916 that received long reviews in the *Review of Applied Entomology*.

After Lounsbury's retirement, Claude Fuller was made Chief for eight months until his retiring age was reached, and at present Dr. T. J. Naudé is the principal entomologist.

Lounsbury's retirement coincided with a rather radical change in the organization of the agricultural service, brought about for administrative purposes. There had been 17 divisions. This number was reduced to six, and the previous Division of Entomology was made to form the Entomological Section of the combined Division of Botany, Horticulture, and Entomology. At the same time the entomological work of a veterinary bearing was transferred to the Division of Veterinary Services.

Under Doctor Naudé, the Entomological Section now provides 14 permanent and five contract posts in entomology. In addition, three entomologists who are functioning as lecturers and extension workers at agricultural schools do research work in entomology under the control of the Chief Entomologist. Also three entomologists on the staff of the University of Stellenbosch do research and extension work (under the auspices of the University) for the Department of Agriculture of the Union Government with which the College of Agriculture of the University is incorporated.

One entomologist, Mr. C. P. van der Merve, has been entrusted with regulations and quarantine as a whole-time job and is assisted by a staff of plant and nursery inspectors. Mr. van der Merve is also Secretary of a Plant Regulatory Board, the additional members being the Chief of the Division, the Chief Mycologist, the Chief Horticulturist and the Chief Entomologist.

In some respects it seems rather a pity that Lounsbury's hope of retaining the autonomy of the Division of Entomology and to include in it absolutely all the work of an entomological character was not fulfilled. There are certain great advantages in the way of such a concentration of entomological effort, as I think has been demonstrated by the Bureau of Entomology in this country. The absolute community of interests and the solidarity of the workers is preserved

by such an organization. I appreciate the administrative reasons for the change in South Africa, but I cannot help thinking that if an organization of somewhat the same character had been effected in this country, as proposed in the early years of the present century, the present Bureau of Entomology functioning (as was proposed) as a division or section of a great bureau of animal industry would not have produced results comparable to those that it has gained, and surely it would not have reached its present advanced condition as a leader in applied entomology and thus as a demonstrator of the vital importance of entomological studies.

Dr. Charles K. Brain has just published a hand-book dealing with South African pests. It is entitled "Insect Pests and Their Control in South Africa." The book covers 468 pages and has 204 illustrations. The groups of insects are considered in order, South African representatives being especially mentioned. Eight chapters are devoted to the treatment. There follow three chapters on beekeeping, diseases transmitted by insects and ticks, and on control measures. About one-half of the illustrations are original. Doctor Brain is now Secretary for Agriculture, Northern Rhodesia. He was formerly Entomologist, Union of South Africa, and Professor of Entomology in Stellenbosch University. The publication of this book is notably important, since it is the first general treatment of the injurious insects of South Africa since the publication of Miss Ormerod's little book entitled "Observations on Some Injurious Insects of South Africa" (1889).

BRITISH COLONIES IN AFRICA, INCLUDING MAURITIUS AND THE SEYCHELLES

The aims of Lord Cromer and the original Central African Research Committee seem to have progressed very favorably in many ways, among them in economic entomology. Important papers have been issued from the various colonies for a very considerable number of years. During the period of publication of the Review of Applied Entomology, for example, from 1912 to and including September, 1929, 319 good papers have been published from such colonies exclusive of South Africa and Egypt.

It has always been confusing to the workers in other parts of the world, and perhaps especially so since the great war, to carry in their minds a definite impression of these African colonies of Great Britain. They include a very large portion of the continent of Africa. We receive many of their publications, and we read with interest the reviews published by the Imperial Bureau of Entomology, but I

imagine that the impressions of most of us are rather indefinite and that it is rather difficult to keep track of the changes in personnel among the workers. England seems to be sending out to her colonies now a well trained and high type of young entomologist and she has had several admirable men in this service, at least since the establishment of the Imperial Bureau.

I have been obliged to consult Doctor Marshall and Doctor Neave of the Bureau about the present (October, 1929) situation as to personnel in most of these colonies, and have, as always, received courteous and authoritative replies. Here are some facts, derived from correspondence and from various publications, which may as well be set down.

Rhodesia.—In northern Rhodesia there is no Government entomologist at present, although some entomological work is carried on by W. Allan, Assistant Agricultural Research Officer.

In southern Rhodesia there is a good force. W. J. Hall, who was in the Egyptian service from 1920 to 1926 and who published several excellent articles, is now Entomologist to the British South Africa Company at Mazoe. The Government of the colony employs R. W. Jack as Chief Entomologist, with J. K. Chorley and A. Cuthbertson as assistants. Another assistant, J. I. Roberts, has resigned. A large number of good papers have been issued from Rhodesia since the beginning of this century, and the agricultural part of the Review of Applied Entomology has given reviews of no less than 70.

Kenya Colony.—Excellent work has been done in this part of Africa for a long time. Well before the World War, T. J. Anderson was appointed Entomologist, and after a visit to the United States where he looked into American methods and spent some time at Washington, he returned to Nairobi in 1911 and has occupied the principal entomological post ever since. His principal assistant at present is T. W. Kirkpatrick who was in the Egyptian service for four years after 1921 and was transferred to Kenya in 1925. C. B. Symes, formerly in southern Rhodesia, was appointed to Kenya in 1925 as Medical Entomologist. H. C. Janes is also Assistant Entomologist. More than 70 entomological publications from this colony have been reviewed.

Uganda.—C. C. Gowdey, a West Indian of American training (Massachusetts Agricultural College), was for a number of years Entomologist to this colony. At present the post is held by H. Hargreaves. The coffee berry moth became of major importance to the coffee growers of Uganda some years ago and Mr. Hargreaves has published extensively on this insect. His article in the Bulletin of

Entomological Research for March, 1926, should be especially mentioned. G. L. R. Hancock holds the position of Assistant Entomologist, and G. H. E. Hopkins that of Medical Entomologist. Mr. Hopkins was transferred from Kenya in August, 1929. In agricultural entomology, there have been published from this colony 39 articles that have been reviewed in the Review of Applied Entomology.

Nyasaland.—The position of Entomologist is held by C. Smee; that of Medical Entomologist by W. A. Lamborn, who, although he has held this post since 1915, was formerly Medical Officer in Nigeria. Twenty-three publications on agricultural entomology have been reviewed in the Review of Applied Entomology from this colony.

Nigeria.—At present in Nigeria F. D. Golding is Senior Entomologist. C. B. Lean is Assistant Entomologist. The official position of Tsetse Fly Investigator has just been vacated by Dr. Ll. Lloyd, who will take up in January, 1930, the position of Reader in Entomology at Leeds University. Doctor Lloyd had held his Nigerian post since 1921. The office of Assistant Entomologist and Tsetse Fly Investigator is held by A. W. Taylor.

Tanganyika Territory.—This colony, established just after the World War, has now a very good entomological staff. A. H. Ritchie, a well trained and well posted man, who came to the United States as one of the early Carnegie Scholars and who afterwards held an entomological post in Jamaica, is the Entomologist. He is allotted four assistants in agricultural entomology. Two of these places are filled by W. V. Harris and W. H. Potts. The other two positions are vacant. There is also a Medical Entomologist, in the person of J. M. McHardy, and a Veterinary Entomologist, W. H. W. Baird. In addition, the well known C. F. M. Swynnerton is Director of the Game Preservation Department and in charge of tsetse fly investigations. Mr. Swynnerton was in Washington two years ago and gave an admirable account of the tsetse fly work under his direction before the Biological Society of Washington.

There has been recently founded in this colony the so-called Amani Institute, and the post of Entomologist to this Institute was taken in 1927 by C. B. Williams who had been four years in Egypt in charge of entomological work. Mr. Williams has just vacated this post, to go to Edinburgh to become Reader in Agricultural Entomology in the University, in place of R. Stewart MacDougall who has retired. Mr. Williams was one of the Carnegie Students sent to the United States before the World War. He went to Trinidad in 1916, in charge of froghopper investigations; and went to Egypt in 1923. He

is the type of man who will make his mark wherever he goes, and has already done very admirable work.

Gold Coast.—At present, W. H. Patterson holds the post of Entomologist. He has been there since 1916 and has published especially on insects injurious to coconut, cacao, and Citrus fruits. G. S. Cotterel is Assistant Entomologist. A. W. J. Pomeroy is Medical Entomologist, and K. R. S. Morris is Assistant Medical Entomologist. In 1914 Mr. Pomeroy was Government Entomologist in Nigeria, and went to the Gold Coast in 1925. Before going to Africa he lived in the United States and was for a time connected with the United States Bureau of Entomology. I am not sure whether at that time he was a citizen of the United States or not. Some excellent publications have come from the Gold Coast, and 30 have been reviewed in the Review of Applied Entomology.

Sierra Leone.—Mr. Ernest Hargreaves holds the position of Entomologist. Mr. Hargreaves was one of the Carnegie Students to the United States before the World War and has been in the colonial service since.

Zanzibar.—The Zanzibar Protectorate, off the coast of Tanganyika, although small, has a good economic entomologist in the person of Dr. W. Mansfield-Aders. The Protectorate published its medical and public health reports beginning with 1915, and since the war Dr. W. Mansfield-Aders has written some very good papers on insects injurious to economic crops. The economic products are cloves and coconuts; and the insect enemies to cotton, cereals, vegetables, fruits, and so on are considered. The clove tree is said to have no specific enemies, although termites attack unhealthy trees.

Gambia.—There is no official entomologist at present.

Somaliland.—There is no official entomologist at present.

Sudan.—There is a first-class staff of entomologists in this colony. H. H. King is Government Entomologist at Khartum, with H. W. Bedford as Assistant. J. W. Cowland is at the field station in the Berber Province; W. Ruttledge at the field station in the Nuba Mountains Province; and H. B. Johnston is at the Gezira Research Farm, with Wad Medani, F. G. S. Whitfield, W. P. L. Cameron, and R. C. Darling.

Mauritius.—This large, rich British island colony in the Indian Ocean east of the African continent is very interesting entomologically and is an especially rich sugar country. Its crops have suffered from insects, and for many years D. d'Emmerez de Charmoy has been interested in applied entomology. He is a well known entomologist

and has written very many important papers. His greater work has been very largely with the insects of the sugar cane. At present he is not only the head entomologist but is the Assistant Director of Agriculture of the island. W. H. Edwards and A. Moutia are Assistant Entomologists.

Seychelles.—There is no official entomologist in this colony, but some very good entomological work has been carried on by the Director of Agriculture, R. R. Dupont.

PART V

AUSTRALASIA AND THE PACIFIC

AUSTRALIA

Australia, with its nearly 3,000,000 square miles of territory and its extraordinary fauna and flora, has offered some very interesting problems to the economic entomologist. During the early part of the last century when the extraordinary character of the animals and plants inhabiting Australia began to be appreciated, many collections of different kinds were made there and among them very many insects were sent over to the British Museum and elsewhere, and may thousands of species were described.

With the introduction from the older countries of many crops, and with the spread of agriculture, beginning seriously after the gold excitements of the middle of the last century, farmers necessarily began to turn their attention to crop pests. Strange things happened in Australia with introduced forms. Wild horses, for example, increased to such extent as to become a pest. The domestic rabbit did the same. Plants introduced for ornamental purposes went wild and multiplied in such a way as to become disastrous. Certain introduced insects did the same. The different States, or colonies, with their independent organizations, handled their own questions through their own experts for many years.

With the joining together of the States, however, in the Commonwealth of Australia, with its newly constructed capital at Canberra and its centralization of government which will rapidly spread out into other than political directions, a sound plan has been devised for agricultural research and a most competent entomologist, Dr. R. J. Tillyard, has been appointed. He has a large and well trained staff and admirable results are sure to come from this organization.

The story of how applied entomology grew in the different States is not a very long one, but it is far from devoid of interest. The important questions of quarantine were, of course, handled independently by the different States. As early as 1892 a plea for general protection was published by Thompson, of Tasmania. His State had already begun operating under partial protective legislation, the so-called Codling Moth Act of 1887. This act was repealed the following year and replaced by the so-called Codling Moth Amendment Acts. Finally, in 1898 the Tasmanian Government passed "An Act to Prevent the Introduction into Tasmania of Diseases, Insect, Fungus, and Other Pests Affecting Vegetation." The spread of the so-called Queensland fruit-fly and of the San Jose scale were the principal incentives.

In 1896 Victoria had passed legislation of this kind, and was followed by New South Wales in 1897 and Western Australia in 1898. Satisfactory legislation by South Australia was not passed until 1910.

A brief but excellent account of economic entomology in Australia was given by Mr. Walter W. Froggatt in his presidential address before the Linnean Society of New South Wales for 1912. In this address he pointed out that before any official Government entomologists were appointed, Sir William Macleay had contributed some notes on insect pests to the Proceedings of the Linnean Society. Froggatt states as his belief that the visits of Albert Koebele and F. M. Webster to Australia on the famous journey that resulted in the importation of the Australian ladybird into California aroused marked interest in entomology and probably had an especial influence in the legislation which followed soon after and which resulted in the appointment of official entomologists in practically all of the colonies. This journey of Webster and Koebele took place in 1888, and not in 1880 as stated by Mr. Froggatt in his address.

The growth of the work in the different States will be described briefly under each State in the following pages, but it should be mentioned here that in July, 1906, a conference of Government Entomologists was held at Sydney and was attended by representatives of South Australia, Tasmania, Victoria, New South Wales, and Queensland. Western Australia was not represented. At that time that colony was, jointly with the State of California, employing Mr. George Compere to search the world for enemies of injurious insects, and there seems to have been some considerable doubt in the minds of the representatives of the other colonies as to the thorough soundness of this procedure, or at least a fear of the danger of too great reliance on what has since come to be known as the biological method of control. (Mr. Compere's employment by Western Australia dates from 1901.) One of the principal subjects considered at this conference was the enormous damage done by fruit-flies. After discussion, a resolution was passed recommending the authorities of the different States represented to send Mr. Froggatt to the United States to inquire into entomological problems. This matter did not eventuate until after a meeting of the Premiers of the different States, in Brisbane in June, 1907. It was then decided that he should be sent to America and Europe, and later, at the request of Queensland, India and Ceylon were added. Mr. Froggatt took the trip, and the report of his investigations was published as a bulletin in 1909. It is probably worth while to state here that he did not endorse the then Cali-

fornia idea of complete reliance upon the biological method and that he discounted many of the claims made by that school of Californians.

I have indicated in the following pages something of the work done in the different colonies down to the latter part of 1929, and have said something about the earlier publications. Australian activity has continued, and it may be worth while to state that, since the beginning of the publication of the *Review of Applied Entomology* (London), the editors of that extremely useful publication have reviewed no less than 904 articles from Australia relating to economic entomology that were published between January, 1912, and September, 1929.

Tasmania.—It was in this colony that the earliest attempts were made to promote economic entomology. While it is true that the agricultural societies and departments of agriculture in the other colonies turned their serious attention to entomological problems at a comparatively early date, the first Codling Moth Act was introduced in the Legislative Assembly of Tasmania as early as 1874. The provisions of this Act were quite as wisely drawn as those of any subsequent injurious-insect legislation. It was not, however, until 1891 that a definite Council of Agriculture was created, and not until 1892 that an official Entomologist was appointed. The Rev. Edward H. Thompson, a clergyman of the Church of England and a naturalist of some distinction, had been writing in the local press and had come into the public eye; and in February, 1892, he was appointed Entomologist and Pathologist to the Council of Agriculture. It is interesting to note that his annual compensation was fixed at 300 pounds, but that in 1894 it was reduced to 200 pounds. He had no funds for expenses and had no assistants.

In August, 1892, the Council of Agriculture began the publication of a journal under the title: *The Journal of the Council of Agriculture*. In 1896 this title was changed to *The Agricultural Gazette and Journal of the Council of Agriculture*. In this form it was published until 1915, when it closed with Volume 23. In the first number of the first volume is the report of a lecture by Mr. Thompson on insect pests, and a report of his work since the first meeting of the Council in May, 1892. Printed reports followed in almost every number of the *Journal* for the first year. Mr. Thompson lectured upon insect pests throughout the colony, and published in 1892 "*A Handbook to the Insect Pests of Farm and Orchard: Their Life History and Methods of Prevention*." This was an excellent and up-to-date publication. Mr. Thompson's last publication in the *Gazette and Journal* appeared in the March, 1896, number, and was entitled "*The Horse Bot-Fly*."

Mr. Thompson published reports in the Gazette for 1895, but in that Journal for November, 1896, he is referred to as "late Government Entomologist." His portrait, published in the Journal for March, 1895, is that of an able, vigorous man, possibly in his late forties.

Mr. Thompson was succeeded in office by Mr. A. M. Lea, previously in Western Australia. Mr. Lea published practical bulletins from time to time until 1914, when his work was taken over by Mr. H. M. Nichols under the title of Government Microbiologist. Mr. Nichols still holds this office, and has published a great deal, more on plant diseases than on injurious insects, and of late years has had charge of the microscopical examination of milk and cream.

Victoria.—The State of Victoria was greatly interested in the Phylloxera as early as 1873. The State had a Department of Agriculture at that date, and its annual report contained entomological articles before there was any definite appointment of an official charged with entomological work. In the report for 1874 there is an account of some Australian wood-boring beetles, by Charles French. Although the Secretary for Agriculture, in an introduction to this article, expressed the hope that this would be the beginning of a systematic inquiry in regard to injurious insects, it was not until August, 1890, that a conference was held at Melbourne, attended by various interested boards and councils, to consider means for the suppression of injurious insects. In 1891 Mr. Charles French was appointed Entomologist to the Government, under the Department of Agriculture. He went to work at once very diligently, and in two years had published two parts of an important handbook on the destructive insects of Victoria, the first published in 1891 and the second in 1893. The reports were written in popular style and gave much attention to means of destruction. Perhaps their most striking feature consists of their illustrations, which are colored. The third part of the handbook, published later, considers also certain valuable insect-destroying birds. I believe that a fourth part was published, but I have not seen it.

Beginning with 1902, there has been published a Journal of the Department of Agriculture. I have seen 25 volumes, down to and including that for 1927. Before the beginning of the first volume, Mr. French had published several bulletins about different insects, as well as a report of the locust plague throughout the north and northwestern districts of Victoria. Articles by Charles French occur in practically every volume of the Journal down to 1908. A number of them were published as formal reports for the current year. In

the report for 1903 he mentions his assistant, C. French, Jr., and one or the other or both contributed articles to the later numbers of the *Journal*.

In 1912 articles by C. French, Jr., are signed "Acting Government Entomologist," and in 1914 as "Government Entomologist." This necessarily means that the son was appointed to his father's position during 1914.

I believe that there has always been a good staff connected with the office of Government Entomologist. I have seen in a *Yearbook of Agriculture* for 1905 the name of Charles French as Entomologist with a staff consisting of C. French, Jr., and 11 other assistants.

Charles French, Jr., still holds the office and is publishing excellent reports. Mr. Walter Froggatt, writing me recently, tells me that Mr. French, Jr., no longer has a staff like that just mentioned, but has a cadet, and is largely engaged in fruit inspection and routine work. Mr. Froggatt also informs me that Charles French, Sr., is living in Melbourne and is about 90 years of age.¹ Mr. Froggatt also tells me that at the National Museum in Melbourne Mr. J. Clark is a great worker and much interested in ants; that Mr. A. L. Kershaw has been interested in insects, and that in the Victorian Naturalists' Club there are some busy entomologists, notably Erasmus Wilson, a coleopterist, and George Lyell, a lepidopterist.

Queensland.—In 1889 Mr. Henry Tryon, who was then an Assistant Curator in the Queensland Museum at Brisbane, prepared a report on insect and fungus pests which was published in the Annual Report of the Department of Agriculture for the year 1889-90. It was a long report, covering 238 pages, and was accompanied by three plates of spraying apparatus. In this report Mr. Tryon referred to the appointment of a board in February, 1875, to "enquire into the causes of diseases affecting live stock and plants." Two thousand five hundred pounds were placed at the disposal of the board during the years 1875 to 1877, and it published four reports. He further states that Dr. J. Bancroft had conducted investigations and referred among other things to the occurrence of certain scale insects on Citrus plants. Doctor Bancroft's publication, which was issued at Brisbane in 1879, was entitled "Diseases of Animals and Plants," and it

¹ While I am reading the proof of this book, I have received a letter from Mr. C. French, Jr., in which he tells me that he is now assisted by Mr. R. M. T. Pescott and that he is conducting a number of important investigations. He also states that his father is still living, at the age of 92, and is still very interested in all entomological matters.

included also some account of the attacks on maize by the larvae of a small moth (*Conogethes punctiferalis*).

Mr. Tryon's official post when he began publishing on entomology was with the Queensland Museum, and it appears that his duties had been largely in connection with the Intercolonial Rabbit Commission of New South Wales and the Stock Disease Board of Queensland. He continued to publish reports under the Department of Agriculture, but was not appointed definitely as Entomologist to the Department until 1895. His title was Entomologist and Vegetable Pathologist and Inspector under the Diseases of Plants Act. He continued to hold this position and published actively until his retirement. These publications occur mainly in the Reports of the Department of Agriculture and also in the Queensland Agricultural Journal which commenced publication in 1897 and is still being published. Almost every volume in the whole series contains entomological articles of some practical importance, and these articles indicate that Mr. Tryon kept well posted as to the entomological work being done in other parts of the world.

Years later Queensland was confronted by an entirely new agricultural problem, namely the overrunning of her great pasture lands by a cactus plant of the genus *Opuntia*. Introduced originally as an ornamental, this plant escaped from cultivation and spread with enormous rapidity and with most disastrous results. Failing to stop its spread by any means at hand, the Queensland Government appointed a Prickly-Pear Commission, and sent Mr. Tryon and Prof. T. Harvey Johnston, a botanist, to America and other parts of the world in search of insects or diseases that would control the *Opuntia*. They arrived in Washington in August, 1913. Mr. Tryon was then apparently about 60 years of age, with a closely-clipped, gray beard, and was quite markedly hard of hearing. Many countries were visited by these men (I think they went quite around the world) and a definite point was finally selected at Uvalde, Texas, where agents of the Commission have been centered for the past 12 years or more. Fortunately, the insect enemies of *Opuntia* had been studied prior to the visit of the Australians, by Dr. W. D. Hunter and Messrs. J. D. Mitchell and F. C. Pratt of Doctor Hunter's force, and a bulletin had been published. Since the establishment of the station at Uvalde, insect enemies of *Opuntia* have been sent to Australia in very great numbers, and, from late reports, at least two of the species sent from the United States have proved to be very valuable and are apparently in the way of stopping the plague.

Mr. Tryon retired from the position of Government Entomologist on December 31, 1925, but was kept on as a Temporary Pathologist

until June 30, 1929. His retirement from public service was marked by a large gathering at the Department of Agriculture and Stock at which addresses were made by the Under Secretary of Agriculture and by others. An account of this meeting and Mr. Tryon's full bibliography will be found in the Queensland Agricultural Journal for August 1, 1929, beginning on page 176.

The prickly-pear work has been continued on a large scale and with very considerable success. The Prickly-Pear Commission is now controlled by the Queensland Government, by the Commonwealth, and by New South Wales. It has a Queensland staff and is independent of the Commonwealth Department of Agriculture. Mr. Alan P. Dodd, a young Queenslander, is Entomologist, and there is a large staff. Mr. Dodd was previously known for his excellent work on certain parasitic insects, especially Proctotrypids. He visited the United States in 1924 and spent some time in Texas, and was appointed to his present post on his return to Australia.

In October of 1929 there was published under the authority of the Commonwealth Prickly-Pear Board a full and well illustrated bulletin entitled "The Progress of Biological Control of Prickly Pear in Australia," by Mr. Dodd. This bulletin gives a full account of the investigations and brings the work down to date. Of the insects liberated, a Lepidopteron known as *Cactoblastis cactorum* seems to be doing the most efficient work. This insect was brought over from the Argentine Republic. More than 300,000,000 specimens of this insect have been liberated since the beginning of 1926, and Mr. Dodd predicts that, at the present rate of increase and with the existing avenues of distribution, it should be prevalent in two or three years wherever prickly-pear occurs in Australia. Two other insects have proved very important, the one a mealy-bug known as *Dactylopius tomentosus* and the other a true plant-bug known as *Chelinidea tabulata*. These species are from the southwestern United States. The *Cactoblastis* breeds rapidly—so much so, in fact, that the Prickly-Pear Board has revised its predictions and anticipates rather speedy success. The most extraordinary amount of destruction of the plants between October, 1926, and May, 1928, is shown by actual comparative photographs.

The officers in charge are taking most extraordinary precaution against introducing insects that might attack cultivated plants. Even some very important enemies of *Opuntias* have been denied admission by the Board, since there seemed to be danger that they would attack other plants. This was notably the case with a large Mexican weevil, *Cactophagus spinolae*, and with a North American moth, *Ozamia clarefacta*.

This *Opuntia* work has been most original and is almost novel in the history of economic entomology, the only prior comparable case, concerning the introduction of insects to kill off a dangerous plant, having been the introduction of insects into Hawaii to destroy the Lantana weed. The effective work of some of the insects, as illustrated in the plates of this report, has been extraordinary. The Board has had frequent changes in personnel among its scientific members and employees. Prof. T. Harvey Johnston, as we have shown, was the first Scientific Controller. He resigned in February, 1923, and the title of the office was changed to Officer in Charge of the Scientific Work. This position was held by Mr. J. C. Hamlin, from the United States, from February, 1923, until May, 1924, when he resigned. He was succeeded by Mr. W. B. Alexander, an Englishman, who resigned in August, 1925. In October of that year the present Officer in Charge, Mr. Alan P. Dodd, was appointed. Australian laboratories are under the charge of Mr. J. Mann, Mr. F. H. Roberts, Mr. A. R. Taylor, and Mr. H. F. Nicholas, while the overseas work is under the charge of Mr. R. C. Mundell, with headquarters at Uvalde, Texas. Mr. Mundell is assisted by Mr. G. Barnette and Mr. M. G. Rodriguez. Uvalde has been chosen as the overseas headquarters since it is easy from that point to visit the most important cactus centers such as the southwestern United States, Florida, Mexico, and Central America.

There is now an excellent organization in Queensland under the Department of Agriculture and Stock, known as the Division of Entomology and Plant Pathology. Mr. Robert Veitch is the Chief Entomologist and Chief of the Division. He had been previously Entomologist to the Colonial Sugar Company and had been stationed at Fiji. Mr. Veitch called in Washington in May, 1914, on his way from England to enter upon the duties of Entomologist to the Sugar Refining Company in the Fiji Islands. He has under him now J. L. Froggatt, in charge of banana insect investigations, and H. Jarvis, in charge of the Stanthorp area. These men have the rank of Entomologist. There are three Assistant Entomologists, G. A. Currie, A. A. Girault, and J. A. Weddell. Mr. Girault is an American, well known for his work on the taxonomy of the parasitic Hymenoptera, and was at one time connected with the Bureau of Entomology at Washington. There are also three assistants of a lower grade. J. H. Simmonds is the Plant Pathologist, with R. B. Morwood as an assistant.

Under this Division of Entomology and Plant Pathology there has been issued this year (1929) a capital book entitled "Pests and Dis-

eases of Queensland Fruits and Vegetables," by Messrs. Veitch and Simmonds. It is a very well printed book of nearly 200 pages and is abundantly and extremely well illustrated. In I. W. Helmsing, the authors have a capital entomological artist. The colored plates are wonderfully well done. The whole book is absolutely Australian, and on the title page appear the words "Wholly set up and printed in Australia."

The entomological work of the Bureau of Sugar Experiment Stations is carried on independently of the Division of Entomology and Plant Pathology of the Department of Agriculture and Stock. Mr. A. A. Girault went from the United States to Queensland in 1911 and served as the Entomologist of the Bureau until 1914. He then returned to the United States, and later returned to Australia and engaged in special work for the Queensland Bureau of Sugar Experiment Stations. In 1914 Mr. Edmund Jarvis joined the staff as Entomologist, and Dr. J. F. Illingworth (another American) became associated with the Bureau in 1917 and conducted investigations for several years. Mr. Alan P. Dodd, now in charge of the scientific work of the Prickly-Pear Board, was also an officer of the Bureau for some years. The present staff consists of Edmund Jarvis, R. W. Mungomery, A. N. Burns, J. H. Buzacott, and W. A. McDugal. The principal efforts of the Bureau have been directed to the solution of the white grub problem, and it has published a number of very comprehensive bulletins. They have also investigated other important sugar cane pests, and a large number of articles have resulted.

Mr. G. H. Hardy, Fellow in Economic Biology at the University of Queensland, has been working for several years on sheep blowflies. He has also been studying the Aphididae. Mr. F. A. Perkins, Lecturer on Economic Entomology at the University, has been working upon fruit-flies.

Entomological work of still another character is being carried on in Queensland independently of the Division of Entomology and Plant Pathology of the Department of Agriculture and Stock. Mr. E. Ballard, an excellent entomologist who had been in the Nyasaland Protectorate as early as 1913 and who had served in India for 10 years as Entomologist to the Government of Madras and elsewhere in south India, came to Queensland in 1924 and held the position of Commonwealth Cotton Entomologist. In India he had made studies of the pink bollworm and of other pests of Indian cotton, and he took up the entomological problems of this crop in Queensland with vigor, publishing in the next four years nearly a score of papers. These were

printed mainly in the Queensland Agricultural Journal and in the Empire Cotton Growing Review.

When C. B. Williams left Egypt in 1928, Mr. Ballard went to that country, where he now holds the position of Chief of the Plant Protection Section of the Ministry of Agriculture. While in Australia, Mr. Ballard was allotted land on farms in each of the chief cotton-growing parts of Queensland, which he used for experimental or observation work and for testing possible methods of control of pests. He found serious problems, and at the time of his arrival the coastal areas, for example, were heavily infested with the pink bollworm. The bolls were infested by the cosmopolitan Noctuid moth, *Heliothis armiger* (or *Chloridea obsoleta*) and also by the Australian peach moth (*Dichocrocis punctiferalis*). There were also cotton-stainers of the genus *Dysdercus* just as there are in the Americas, and other true bugs doing similar work.

Dr. R. Hamlyn-Harris, an Englishman who had held for a brief time an entomological position in the West Indies, went to Australia in 1902 and was engaged for seven and a half years in the Queensland Museum as Director. His health failing, he went into the country for a time and engaged in the study of the diseases and insect pests of fruit trees in the field. In 1922 he took the position of officer in charge of the central office laboratory—Malarial and Filarial Survey of Southern Queensland under grants from the Rockefeller Foundation. He is now and has been since 1926 City Entomologist of Brisbane under the Department of Health. He has made some most interesting observations relating to mosquitoes and disease and has published a number of important papers.

We must not leave Queensland without mention of the excellent work done by Margaret E. Temperley, who seems to be an excellent observer and altogether a most competent person. For example, in the April, 1930, number of the Queensland Agricultural Journal there is an admirable and beautifully illustrated article by Miss Temperley entitled "Life History Notes on the Banana Fruit-Eating Caterpillar (*Tiracola plagiata* Walk.)." She gives a very full account of the life history of this destructive insect. The two colored plates covering this article were drawn by Mr. Helmsing whose name is mentioned in a previous paragraph. They could not have been done more skillfully.

South Australia.—The first work on injurious insects in South Australia was apparently done by Mr. Frazer S. Crawford who interested himself for a number of years before his death in the study of insects and fungus pests. It was due to Mr. Crawford that the famous

expedition was sent from the United States to Australia that resulted in the importation of the Australian ladybird and the control of the white scale in southern California. Mr. Crawford sent specimens of a parasitic fly, that afterwards became known as *Lestophonus iceryae*, to Miss Ormerod in England, who forwarded them to Professor Riley in Washington, thus starting the correspondence between Professor Riley and Mr. Crawford which gave the people in the United States practically the first information that in South Australia the fluted scale was controlled by parasites or predators.

When Koebele arrived at Adelaide, South Australia, on October 2, 1888, he carried letters of introduction to Mr. Crawford whom he found at his post in the office of the Surveyor General.¹ Koebele states that Mr. Crawford received him in a very kindly way and that he promised him his assistance, which promise was honorably fulfilled throughout Koebele's stay in Adelaide. On October 15 Koebele made a trip with Messrs. Crawford and J. G. O. Tepper to North Adelaide where Koebele discovered for the first time, feeding on a large female scale, the ladybird which has since become so famous, *Novius (Vedalia) cardinalis*. Koebele stated in his report that he called the attention of both the gentlemen to the insect, yet neither of them had ever seen it or knew the beetle. The first shipment of the valuable beetle was made from specimens secured at Mannum on the Murray River.

The Agricultural Bureau of South Australia was established in the late 1880's and in its reports there are occasional references to insect pests. When specimens were received by the Bureau, from that time on, they were referred, where necessary, to Mr. Crawford, to Mr. J. G. O. Tepper of the Museum, to Mr. Olliff, Government Entomologist of New South Wales, or to Mr. Charles French, Government Entomologist of Victoria.

For a number of years Congresses of Agriculture were held at Adelaide, and at the first one, held March 4-7, 1890, Mr. Crawford made a long report on insects and fungus pests which was published and was illustrated by four etched plates. He paid especial attention to the codling-moth and stated that it was then four years since he first gave the alarm that the pest was present in South Australia. He stated further that it had long been rampant in Tasmania. Had Mr. Crawford lived, it is likely that he would have been appointed official Entomologist to the colony of South Australia, but after his death in 1890 a vivid interest in entomology was kept up, largely through

¹ He was a photolithographer in that office.

the interest shown in the matter by Garden and Field, an important agricultural paper published at Adelaide, the editor of which, Mr. W. C. Grasby, visited the United States and was very appreciative of the work done here. He was an early foreign member of the American Association of Economic Entomologists.

One of the early writers in South Australia was Mr. J. G. O. Tepper, who for many years held the position of Curator of the Entomological Department of the South Australian Museum at Adelaide and acted as Consulting Entomologist for the Department of Agriculture. He was also consulted by other colonies. Mr. Tepper died in 1922 but had retired at the age of 70 and was succeeded by A. M. Lea, who is now Entomologist to the Museum and Consulting Entomologist to the Department of Agriculture. Mr. Lea has been connected with the Museum since 1911.

In 1894, Mr. George Quinn, Horticultural Instructor and Chief Inspector of Fruit under the so-called "Vine, Fruit, and Vegetable Protection Act," became connected with the Department of Agriculture for the purpose of carrying out the law and trying in a general way to place horticulture on a sound footing. This law empowered the authorities to deal with and regulate the introduction into the State of fruits, plants, insects, and diseases, and to make regulations for enforcing attention to any which might be already found injuring plant life in the State or which might from time to time be introduced. The law seems to have been rigidly enforced. In many cases disinfection by hydrocyanic-acid gas was carried on, charges being imposed on the importer covering the expenses. Under Mr. Quinn's direction, demonstrations in spraying experiments were carried out in the gardens of South Australia, and he worked for years in testing remedies, publishing bulletins and in giving lectures and personal advice. He had a good force, consisting at times of as many as 12 men. Some of Mr. Quinn's more important publications have related to spraying against the codling-moth, to the banded pumpkin beetle and to the fruit-maggot fly pests.

The Journal of the Department of Agriculture of South Australia, which began its publication in August, 1897, under the title "The Journal of Agriculture and Forestry" and which ran for seven volumes under that title, is still being issued, and has always contained many shorter notes on injurious insects, published either editorially or as quotations from other journals.

It seems strange that South Australia has never had a paid official economic entomologist; but her inspection force, in combination with

competent advice from the South Australian Museum, seems to have handled the situation fairly satisfactorily.

Quite recently there has been founded in South Australia the Waite Agricultural Research Institute under the University of Adelaide. This Institute was established for the purpose of furthering the cause of education and research in agriculture and allied subjects. Buildings have been erected upon large estates at Glen Osmond four miles from Adelaide. The active work began in 1925. From public funds, from funds contributed by the Empire Marketing Board, and from gifts by individuals, the Institute has assumed shape and promises admirable work. Arrangements have been made for entomological research. An exceptionally well trained man, Dr. James Davidson, formerly of the Rothamsted Station in England, has been appointed Entomologist and is now on the ground and at work. Doctor Davidson while noted for his investigations of the Aphididae, is a broadly trained man and admirably fitted to handle the entomological questions of importance in South Australia.

New South Wales.—In 1885 a young Englishman named A. Sidney Olliff went from London to Sydney to accept the office of Entomologist to the Australian Museum. He was a young man of great promise. Before leaving London he acted as volunteer assistant to Mr. C. O. Waterhouse in the British Museum and later was secretary and scientific assistant to Lord Walsingham. He was only 20 years of age when he reached Australia, and he had already published entomological papers in England. After arriving at his new post his published papers in the Proceedings of the Linnean Society of New South Wales were numerous.

The Agricultural Gazette of New South Wales was started under the Bureau of Mines and Agriculture in 1890, and Mr. Olliff began at once to contribute many important articles to this journal on entomological subjects. It was only natural, therefore, that Mr. Olliff should have received the first appointment to the charge of the Entomological Branch of the Department of Mines and Agriculture. In a series of entomological bulletins begun in 1892 his name appears upon the title page as "Government Entomologist, New South Wales," but his appointment obviously dated from 1890. The first number of the Gazette contains an important article of his on the codling moth, and the subsequent numbers contain frequent valuable articles, nearly all very well illustrated. The volume for 1891, for example, contains no less than 19 such articles; that for 1892 has 20. He continued this important work until he died at the untimely age of 30 in 1895. He had, however, built up a sound reputation. We

were publishing the journal "Insect Life" in the Division of Entomology of the United States Department of Agriculture at that time, and I well remember with what sound satisfaction his bulletins and articles were received and the great pleasure I had in giving them full reviews so that they would become known to the 3,000 or more people who received *Insect Life*. His obituary was published on page 1 of Volume 7 (1896) of the *Agricultural Gazette*, and a list of his published papers was added. This list comprised 72 titles.

About this time Mr. Charles T. Musson, a professor in the Hawkesbury Agricultural College, began to publish in the *Gazette* notes on entomological subjects. This college was a Government institution under the Department of Agriculture, and economic entomology was dealt with, and a course of 32 lectures with 15 practical exercises was given in the second year of the student's residence. Professor Musson, however, covered in his work, not only entomology, but also botany, vegetable pathology, and nature study. And he had only one general assistant.

It appears that at the time of Olliff's death, Claude W. Fuller was holding the post of Assistant Entomologist. His first independent article occurs in the *Gazette* for January, 1896, and is entitled "Insect Friends and Foes." In a later number an article by Fuller entitled "Insect Pests" carries under his own name the title "Acting Entomologist." In the final number of the volume, an article by Fuller entitled "Plant Galls formed by Insects" carries under his name the title "Entomologist." So, before the year was out he had been formally given Mr. Olliff's post. The most important article by Mr. Fuller in this volume is entitled "Bovine Tick Fever." It covers 27 pages and a number of plates. Mr. Fuller's subsequent career was in South Africa—first in a post in Natal, afterwards under the Union of Federated States—and apparently he left Australia in the early part of 1897.

Fortunately, the colony had, in the person of Mr. W. W. Froggatt, a sound entomologist employed in the Technological Museum at Sydney, who had already published under the "Technical Education Series" of leaflets at least one important paper bearing upon economic entomology. Mr. Froggatt was appointed successor to Fuller; took up the large correspondence upon entomology; traveled throughout the State making investigations and giving lectures. He established an insectary where he carried on necessary breeding tests, and conducted a laboratory and an office in Sydney. His activity was very great, and in the volumes of the *Agricultural Gazette* from 1899 to 1906 inclusive are printed no less than 131 signed articles.

In addition, early in 1907, he published a large volume entitled "Australian Insects" which covers 449 pages and carries 37 plates and 180 text figures.

In 1907 he took his trip around the world that has already been referred to.

In later years New South Wales has continued to be very active. Mr. Froggatt held office until 1928. After his return from his circumnavigation tour, he continued his activities and published many articles in the Gazette and elsewhere. In June, 1928, he was given a farewell dinner by his colleagues in Sydney. I believe that he now has a post in the Forest Department.

Mr. Froggatt was succeeded by Mr. W. B. Gurney who had been Assistant. Mr. Gurney began to write as early as 1912, and the first article of his that I have seen was on the subject of fruit-flies and other insects attacking cultivated and wild fruits in New South Wales. He continued to publish articles in the ensuing volumes. He was present at the Fourth International Congress of Entomology at Ithaca, New York, in 1928 as an official delegate from Australia.

Mr. John L. Froggatt, son of Mr. W. W. Froggatt, was at one time an Assistant Entomologist in New South Wales, and his name appears as coauthor with his father of two articles in the Gazette for 1914. As appears elsewhere, he is now Assistant Entomologist in Queensland.

The October (1929) number of the Agricultural Gazette of New South Wales has an excellent article called "Preliminary Experiments in Cabbage Moth Control," by W. L. Morgan, "Assistant Entomologist" which shows that Mr. Gurney is by no means working single-handed.

Western Australia.—Western Australia, naturally, as one of the newer colonies, was somewhat behind the others in beginning work with entomology. However, the Bureau of Agriculture of the colony began publishing a journal in 1894 in which the passage of an insect pests act was advocated in the first volume, which also published different notes upon insects, quoted from other publications. The second volume of this journal contained a number of articles on insects, some of them by Arthur M. Lea, who signed as Entomologist of the Bureau.

I am not sure how long Mr. Lea kept this post. He afterwards went to New South Wales and became connected with the Australian Museum.

In the Journal for 1902 was published a letter from George Compere, of California, relating to his search for parasites. He had been

engaged by the colony in 1901. In 1904 Mr. Compere was employed jointly by the State of California and by the colony of Western Australia to import parasites of destructive insects.

In the second volume of the *Journal* for 1903, apropos to the belief in Western Australia of the claims of the parasite school of Californians, a letter from Prof. C. W. Woodworth, of Berkeley, California, was published, in which he stated bluntly that the California statements had been exaggerated; that California had then very many insect pests, and that the cottony cushion scale was the only one held in check by its enemies. This letter was answered by Mr. Compere in the *Journal*, and naturally the answer was very satisfactory from the point of view of the advocates of natural control, but nevertheless it contained misstatements and was misleading. It is interesting to note that in the *Journal* for 1904 was published an article by W. B. Wall, reprinted from the *California Fruit Grower* "entirely bearing out the statements made by Mr. Compere." In this article some unfortunate statements were made, as, for example, in referring to John Isaac, he quotes from him and calls him "one of the best known horticultural writers in America."

In 1903 and 1904 Mr. Compere was on his journeys, and in the number for August 15, 1904, it was announced that he had returned, bringing with him "the parasite of the fruit-fly as well as some other valuable insects." And on pages 68 to 72 is his report. Among other things, he says "The Staphylinid beetles beyond question destroy the major part of the fruit-fly parasites in Brazil." This was one of his characteristically optimistic statements. He always seems to have seen only one side of the question, and his Staphylinid importation was a flat failure. Moreover, the visit of Lounsbury and Fuller from South Africa to Brazil failed to substantiate Compere's statement as to the efficacy of the Staphylinids. Apparently Western Australia gradually lost confidence in Mr. Compere. In the *Journal* for 1907 he is still referred to as Entomologist to the State, and claims to have successfully imported parasites of the soft brown scale and the grape scale from California into Western Australia. It may be worth while to give, as a good example of the looseness of Mr. Compere's statements about this time, the following quotation referring to a species of *Lecanium*: "Some years ago Mr. Ehrhorn discovered its parasite, *Comys fusca*." This common parasite of *Lecanium* scales had been known to all good entomologists for very many years. I had studied it, and in fact named it, here in Washington nearly 30 years earlier.

During the time of his employment in Western Australia he secured from the British Museum in London an assistant, Mr. Frederick

D. Lowe. Mr. Lowe stayed with him for a short time and then went back to England where I met him in 1906 or 1907 and heard his story of his disagreement with Mr. Compere's statements and conclusions. In 1904, Mr. L. J. Newman became Compere's assistant and succeeded him as Entomologist to the Bureau of Agriculture of Western Australia. The first of Mr. Newman's publications to which we have any reference is dated 1907. The statement is made in the same number that during the absence of Mr. Compere, traveling in different parts of the world, "the newly appointed Assistant Entomologist, Mr. L. J. Newman, attends to the reception of consignments," etc. The Report of the Department for 1908 is signed by Mr. Newman as Assistant Entomologist.

Mr. Compere resigned his Australian post in 1910 and returned to California where for many years he held a post under the State Government, engaged largely in port inspection under the State plant quarantine regulations. His earlier work, backed enthusiastically by Mr. Elwood Cooper, seems to have been practically void of good results, and it is a pity that a man of such indomitable energy and of so much resource should not have had a sound training in entomology and in scientific methods. He was the right hand of the element in California that really delayed the progress of entomology in that State for some years as we have pointed out in the section on California.

Mr. Newman remained acting Entomologist to Western Australia, after Compere's resignation until 1918 when he was made Entomologist and has been active and apparently efficient. The colony was publishing spraying calendars and information about spraying in 1908 and again in 1913. Evidently as early as 1908 reliance upon natural enemies was weakening. Mr. Newman's recent publications have covered a variety of subjects, but they are very well done. I am inclined to doubt his assertion that the importation of *Aphelinus mali* into Western Australia through Doctor Tillyard has resulted in the parasitism of other aphids by this parasite, but that is a matter that will be cleared up.

Northern Territory.—The agriculture of the Northern Territory was at one time looked after by the Department of External Affairs at Melbourne, and later by a so-called Administrator; and G. F. Hill acted as Entomologist. In a report published in 1915 he gave an extended account of the insect pests of plants in the Territory, and another report contains additional accounts of injurious insects, with especial mention of experiments in the control of termites.

NEW ZEALAND

The naturalists who accompanied Captain Cook on his voyages of 1769-70 and 1773-74 collected some New Zealand insects, and the species were later described by Fabricius and Swederus. Much later expeditions incidentally collected New Zealand species, and with the gradual settlement of the islands residents began to collect and send specimens to England. Toward the latter part of the nineteenth century entomologists resident there began to appear, and W. M. Maskell and F. W. Hutton, for example, took up the study of insects and described many species.

Economic entomology made its first appearance in the 1890's when T. W. Kirk was appointed Biologist to the State Department of Agriculture. He organized the biological branch of the Department which was destined to take the leading part in the study of the economic problems of the country. Professor Kirk was responsible for the study and recording of the major pests and for the introduction of many beneficial insects, among them *Novius cardinalis* against *Icerya purchasi*, *Rhizovius ventralis* against *Eriococcus coriaceus*, and of bumblebees for the pollination of clover. In 1900 A. H. Cockayne joined the staff, and, on Kirk becoming Director of Horticulture, he became biologist and held the office until 1924. The Biological Division of the Department of Agriculture grew into a large organization, and in 1916 David Miller was appointed to the staff as Government Entomologist and organized a specific entomological service for the Dominion. Outstanding investigations were taken up on the pear midge (*Perrisia pyri*), the grass grub (*Odontria zealandica*), the sheep maggot fly, and forest entomology.

A wealthy and public-spirited citizen of Nelson, Mr. Thomas Cawthron, died in 1915 and left in his will something over a million dollars to be devoted to scientific research. The Board of Trustees decided to devote the income of most of this sum to scientific research relating to agriculture, arranged quarters at Nelson and started research operations in 1920. Dr. Robin J. Tillyard, an Englishman and a graduate of Cambridge University, who had been connected with the University of Sydney (Australia), was appointed to take charge of the entomological work of the Institute. Tillyard began at once to push the subject of natural control, and, with the help of the Federal Bureau of Entomology of the United States and the Imperial Bureau of Entomology in London, began the importation of several parasites of several imported pests of importance. He achieved a notable success against the woolly root-louse of the apple by means of the importation of *Aphelinus mali* from the United States, and in time

doubtless others of his importations will assume importance. He showed himself very pronounced in his ideas as to the value of the importation of the insect enemies of dangerous plants; and, the blackberry having spread alarmingly in New Zealand, and encouraged by the reported success of the insect enemies of the lantana weed in Hawaii, he has made efforts to introduce blackberry insects into New Zealand. It was during his residence in New Zealand that Dr. Tillyard's remarkable book "The Insects of Australia and New Zealand" was published. It contains 560 pages and is abundantly illustrated and contains some admirable colored plates. It is full of original observations and is a wonderful book.

In 1928 the Commonwealth of the States of Australia having constructed the new capital at Canberra and founded the Federal Department of Agriculture, Doctor Tillyard was appointed to take charge of the entomological work in that Commonwealth and left New Zealand. He was succeeded by Dr. David Miller and the Entomological Department of the Cawthron Institute was extended, and the entomological research for the whole Dominion of New Zealand was centralized in Nelson.

Occasional published references will be found to the fact that at one time bumblebees (humblebees) were introduced into New Zealand to bring about the fertilization and seeding of red clover; but the exact facts in the case were not fully displayed in print until 1914 when the New Zealand Department of Agriculture, Industries, and Commerce published as Bulletin 46 (new series) a pamphlet entitled "History of the Humble Bee in New Zealand: Its Introduction and Results," by I. Hopkins. It seems that Mr. Hopkins, who was formerly Chief Government Apiarist, had started large bee farms in the years 1882 to 1887. Although thousands of acres of red clover adjoined his bee farms, he found that the hive bee visited the clover only occasionally and that seeding was far from perfect. He concluded that the hive bee simply collects pollen from red clover when it is scarce elsewhere, and is consequently seen on the plants only occasionally. Attempts to introduce humblebees from England were made as early as 1870, but failed. Mr. Hopkins began to try to bring them over in 1880. All attempts failed until 1885, when 48 were landed safely. The progeny of these bees spread over the country during the first few years with remarkable rapidity. Whole nests and queens were sent from Canterbury to various parts of the North Island. The species introduced proved to be two in number, namely *Bombus terrestris* and *B. subterraneus*.

The results appear to have been perfect, and, whereas it had previously been possible to grow only a few seed, fertilization was, after the introduction, found to be almost perfect; almost every head was full of "fine, plump seed." In 1913 the seed yield on one farm reached 720 pounds per acre.

At the end of his writing, Mr. Hopkins stated that "Not a trace of any change of habit (except perhaps in the period of hibernation) had been noticed in the bees from those natural to them in their original home."

A comparatively early knowledge of the insects of New Zealand was, curiously enough, due to three old soldiers, Capt. F. W. Hutton (1836 to 1905), Maj. Thomas Broun (1838 to 1919), and W. M. Maskell (1840 to 1898). Mr. Maskell went to New Zealand in 1860, Major Broun in 1863, and Captain Hutton in 1866.

Captain Hutton served for some time as a midshipman in the Navy. Later he received a commission in the Royal Welsh Fusiliers, saw active service in the Crimea and in the Indian Mutiny. In 1860 he joined the Geological Society of London, and in 1862 published a paper on the use of geology to military officers. In New Zealand he joined the Geological Survey Department, and continued through the rest of his life to work upon the geology and zoology of the islands. He was in 1880 Professor of Biology at Canterbury College, staying there for many years. He was Curator of the Canterbury Museum at the time of his death, which, however, did not occur in New Zealand but on his way back from England where he had gone on leave of absence. His work covered a very broad range of zoological subjects, and on entomology he published over 30 papers of systematic importance.

Major Broun joined the Army at the age of 16, during the Crimean War, and after the close of that war accompanied his regiment to Burma. Here he became attracted by the large size and brilliant colors of many of the tropical insects, and began to collect for the British Museum. Then came the outbreak of the Indian Mutiny, and his regiment served in India during the whole period of the Mutiny. He was present at the assault and capture of Delhi and at the relief of Lucknow. He retired from the Army in 1862, married, and later went to New Zealand. Then the Maori War broke out. He was commissioned as a Captain and served the whole war. He worked with the Auckland Board of Education, and remained in the service until 1886. He was appointed Government Entomologist in 1890, holding the post until 1907. From the close of the Maoric War until his death he worked with insects. He knew the Hemiptera and Orthoptera and

had a good working knowledge of most of the other orders, but he was primarily a coleopterist. He intended to prepare a general work on New Zealand Coleoptera, and he was very industrious in describing his species. He became known to entomologists all over the world.

Mr. W. M. Maskell was born in England in 1840, and died in New Zealand in 1898 after a surgical operation. He was educated in England and in Paris, served in the Army for a short time, and went to New Zealand in 1860, where he was for some years a sheep farmer. In 1887 he became Provincial Secretary and Treasurer of Canterbury Province. Toward the end of his life he was Registrar of the University of New Zealand. I should mention that he began originally as a microscopist and gradually became interested in the Coccidae, Aleurodidae, and Psyllidae, although he also worked on the Desmids in botany. He planned to do a large work, in parts, on the insects noxious to agriculture and plants in New Zealand. Of this, he published one part, the scale insects, which was issued in book form in 1887 by the Department of State Forests and Agriculture at Wellington. He had previously been describing species in the Transactions of the New Zealand Institute and was well known as a careful student who had the delightful task of being the first to investigate a new fauna. His book is not large, covering only 116 pages, but it is illustrated by 22 carefully drawn plates. He was the first to describe several species that have since become widely distributed and of very considerable economic importance. The famous cottony cushion scale, or fluted scale (*Icerya purchasi*), was first described by him, in the Transactions of the New Zealand Institute for 1878.

Dr. David Milner, now Chief Entomologist and Director of the Forest Biological and Noxious Weeds Control Researches at the Cawthron Institute, was born in Scotland in 1890. He was appointed Government Entomologist in New Zealand in 1916, holding this post until 1928, when he succeeded Tillyard at the Cawthron Institute. For some years prior to 1928 he also acted as Lecturer on Forest and Agricultural Zoology in the New Zealand University and as Consulting Zoologist to the State Forest Service. Since his establishment at the Cawthron Institute the Entomological Department of that Institute has become recognized as the central entomological research station for the Dominion. Doctor Miller has taken hold of this work with great enthusiasm.

In the spring of 1930 he spent some time in the United States, on his way to the meeting of the Imperial Bureau in London. In fact, he is in Washington at this time of writing (April, 1930). He expects to visit South America on his way back to New Zealand and to at-

tempt some interesting importations of beneficial insects. I expect great things from this comparatively young, well trained, and enthusiastic man.

THE PHILIPPINES

Many collections had been made in the islands of the Philippine Archipelago, and many of the species were to be found in the different great collections of the world before the Spanish-American War. In fact, the fauna had attracted the attention of many naturalists. In 1895 and 1896 a large three volume systematic catalogue of the fauna of the Philippines was published by the College of Saint Tomas in Manila, prepared by Fr. Casto de Elera, Professor of Natural History and Director of the Museum of the Dominican Fathers of the "Colegio-Universidad" of Saint Tomas. Volume 2 of this great catalogue comprises the Articulata. It is little more than a list of species, but covers 676 large octavo pages. In the foreword, the following well known entomologists are mentioned as having worked upon Philippine insects: G. A. Baer, Maur, Reginbart, O. Mohnike, F. Chapuis, Roelofs, Candéze, Selys Longchamps, Osten Sacken, C. Stål, Semper, Staudinger, E. Grube, and Ignacio Bolivar. Of the 676 pages of this volume on the Articulata, 525 pages are devoted to insects. This great catalog was brought together by the author for the Regional Philippine Exposition.

Soon after the Spanish-American War, added collections began to come in to the museums of the United States and to the European museums. For example, Fr. Robert Brown, S. J., Fr. W. A. Stanton, S. J., of the Observatory at Manila, and Dr. P. L. Stengl of the United States Army sent collections to the United States National Museum in Washington; and the late Dr. W. H. Ashmead published in 1904 and 1905 some papers on the Hymenoptera of the Philippines based principally on material sent in by these men.

About that time Dr. C. H. T. Townsend accepted a teaching position in the Philippines and went over there for a number of months, and of course did a certain amount of collecting, although I do not recall that he published anything about the Philippine fauna.

Following the war also came the establishment of the Philippine Government Laboratories, afterwards changed to the Philippine Bureau of Science with Paul C. Freer as Director. Mr. C. S. Banks, who had been an assistant of Dr. E. P. Felt, the State Entomologist of New York, passed a Civil Service examination and was engaged by the Government Laboratories in December, 1902. He was immediately sent to the Island of Negros to study insects affecting the cacao.

J. L. Webb, subsequently for many years connected with the Federal Bureau of Entomology at Washington, entered the Philippine Government Laboratories in 1903, to take up the study of forest insects in the Archipelago, but remained in the islands only a few months, working mainly under the direction of the Bureau of Forestry of which Capt. George P. Ahearn was chief.

Mr. Banks soon became interested in biting insects and took up systematic study of the mosquitoes. His report on cacao insects was published on pages 597-620 of the Report of the Secretary of the Interior, 1902-3. It was illustrated by a large number of admirable half-tone plates.

By 1907 Mr. Banks had found 100 species of mosquitoes in the island, and had built up a considerable entomological collection. He was given an assistant, Willie Schulze, who was working with him certainly before 1908.¹ In 1910 Charles R. Jones, an American, was appointed to help in the economic aspects of the work, and was transferred in 1912 to the Bureau of Agriculture in connection with locusts.

Mr. Banks took up the subject of silk culture and prepared a manual of silk culture. He further made an investigation of the insects affecting tobacco. In August, 1914, he was transferred to the University of the Philippines, returning to the Bureau of Science in 1919.

Mr. Schulze resigned and entered commercial life in 1913. He had built up a large collection of Coleoptera and Lepidoptera and had completed a catalogue of Philippine Coleoptera.

When Mr. Banks returned to the Bureau of Science he brought all of the collections, equipment, and books back to Manila, and in 1919 the collection of insects was said to approximate 350,000 specimens.

Mr. Banks retired in June, 1922, and Mr. Schulze came back into the service, resigning finally in 1927.

Mr. David B. Mackie, of California, entered the service of the Bureau of Agriculture as Inspector in 1912, and was in charge of the migratory locust campaign from its inception until 1918. The Government appropriated from 50,000 to 100,000 pesos a year and maintained a very active campaign, conducting its work through the Bureau of Agriculture and through the local provincial governors. At the peak of the locust outbreak, as I am informed by Mr. Mackie, practically every province in the Archipelago was infested. During his term of office—and he was later termed Entomologist—Mr.

¹ Mr. Webb tells me that he remembers Mr. Schulze very well in 1903. He went with him on one or two extended trips. At that time Mr. Schulze knew no English.

Mackie did a great deal of valuable work. He prepared an article on coconut pests, and did the first work on vacuum fumigation in his efforts to destroy the cigaret-beetle, or cigar weevil as it is sometimes called (*Lasioderma serricorne*). He had four vacuum fumigators installed, and 6,000,000 cigars were treated and sold in the early work. In 1913 he organized the first plant quarantine service, and later published a number of very interesting articles. The details of his fight against the locusts are important and very interesting. He also did some work on fruit-flies.

Following Mr. Mackie's separation from the service, Mr. Gonzalo Merino was placed in charge of pest control for the Department of Agriculture.

The large collections brought together by Mr. Banks had been studied by experts in different parts of the world and reported upon, but, large as they were, they sank into comparative insignificance when Dr. C. F. Baker got fairly started at his important work. Doctor Baker was a very extraordinary man, who had studied entomology at the Michigan Agricultural College, where he graduated in 1892, and afterwards worked with Professor Gillette in Colorado and later with Professor Cook at Pomona College in southern California. Afterwards he worked at the Cuban Experiment Station at Santiago de las Vegas, and still later in Brazil where he made enormous collections of both plants and insects which were presented to Pomona College when he returned in 1908. Baker was appointed Professor of Agronomy in the University of the Philippines in 1912, subsequently becoming Dean. He worked incessantly with insects, built up extraordinary collections, and died in harness in 1927. His collections had been sent to very many scientific centers in different parts of the world and were thus identified by the world's best specialists. His will gave these collections to the United States National Museum, and, after his death, Mr. R. A. Cushman went to the Philippines and packed them carefully; and they are now in Washington.

The journal known as "The Philippine Agriculturist and Forester," published by the College of Agriculture of the University of the Philippines at Los Baños, was started in January, 1911. Professor Baker was a contributor, and the journal shows his intense interest in investigation work and also his very great interest in the young Filipinos and his belief in them. His editorial reply to criticisms published in No. 1 of Volume 16 is such an eloquent tribute to young Filipinos that there is no wonder he inspired admirable work.

In 1909 the Bureau of Agriculture of the Department of the Interior began publication of The Philippine Agricultural Review in

Spanish and English. This excellent journal is still being published, and through its volumes are scattered very numerous important articles on injurious insects. In the last number received in Washington the organization of the Bureau of Agriculture is displayed on the inner cover, and no strictly entomological officer is mentioned. Mr. Gonzalo Merino is still Chief of the Plant Pests Control Division. In this number is an important article entitled "Some Notes on the White Pyralid Moth Borer (*Scirpophaga innotata* Walker) and Suggestions for its Control," by Pedro L. Sison. Earlier volumes contain articles by Leopoldo Uichanco, H. E. Woodsworth, and others. In the volume for 1923 is the first article by Faustino Q. Otones. Mr. Otones was in the United States in 1922 studying in preparation for an official position in the Philippines. He visited Washington and spent some time studying the organization and methods of work in the Federal Bureau of Entomology. Articles by Mr. Otones occur in the Agricultural Review for 1924, 1925, 1926, and 1927. In the number for the first quarter of 1927 he is given the title, Acting Chief, Plant Pests Control Division; in that for 1926 he is the author of an article, and to his name is attached the title Entomologist.

Aside from official work in economic entomology, the Victorias Milling Company on the Island of Negros and the North Negros Sugar Company, in the autumn of 1927 engaged Dr. W. Dwight Pierce (for many years connected with the United States Bureau of Entomology) for two years to go out to Negros and study the insects affecting the sugar cane. Doctor Pierce went to the island in August, 1927, and remained until March 1, 1930, when he returned to the United States with large collections and is now engaged in taxonomic work on these insects. In Negros he was given an excellent salary, a first-class laboratory outfit, and four collectors and assistants.

He found a very large number of primary sugar cane pests, which complicated the situation very materially. There were ten species of borers causing dead-heart, and in order to obtain control of these it was necessary to have several series of parasites. Up to February, 1928, he was practically unable to find any parasites. In this month the egg parasitism of the principal borer (*Olethreutes schistaceana*) amounted to less than six per cent as an average over the territory involved. By adopting a system of redistribution of parasites in small units to many foci, he quickly brought the average parasitism in three months to over 80 per cent. There was a drop in parasitism which accompanied the great reduction in the host numbers, but from

March, 1929, to the termination of his employment there was an average parasitism throughout the entire territory of over 70 per cent. This parasite was *Trichogramma nana* Zehnt.

The second species was *Diatraea infuscatella* Zehnt. This borer became the primary borer as the *Olethreutes* was reduced in numbers, but its egg-parasite (*Phanurus beneficiens*) gained very rapidly under the system of field redistribution, so that its parasitism was over 50 per cent at the time of leaving. Larval parasitism was very low, but the same system of redistribution was followed and the mean parasitism of all borers showed an upward trend in a six month period.

Extensive studies were made of the weevil borer, *Trochorhopalus triangulatus*. This borer was unknown to the sugar planters, the dominant pest of sugar cane on the Island of Negros, causing more permanent damage than the dead-heart borers although the latter were apparently causing 20 to 30 per cent injury. This is because the dead-heart borers' damage was replaced by a subsequent growth whereas the damage by the beetle borer was final. Tests were made of the damage on many cars, and analyses in the mill proved that the average damage was between two and three per cent loss of sugar, which amounted to over a million pesos in the territory involved. No parasites were found, but the obvious method of control seemed to be the handling of waste. The practice in the Philippines is to burn the waste after harvesting the cane, but usually large quantities of sticks remained in the field. His recommendation, made in March, 1928, to pick up and burn all pieces of cane left in the fields was probably the most practical measure available at the time. This was followed by many planters, and may be the reason for the gradual reduction in damage shown by investigations of the cars.

The program of work followed out was divided into a survey of the entire entomology of sugar cane and its surroundings, the mapping out of a complete program of cultural control,¹ and the distribution of parasites. The results of this work are embodied in a series of six reports on the insects and one on the climate, published by the Victorias Milling Company.

Shortly after Doctor Pierce arrived at his Philippine post he wrote me that Dr. J. W. Chapman, a specialist on ants, was teaching zoology at the Silliman Institute at Dumaguete, Oriental Negros, and that in addition to himself and Doctor Chapman the only other ento-

¹ Doctor Pierce's recommendations in regard to cultural operations, involving especially clean culture, were of such character as not to seriously interfere with the generally adopted practice. They were economical and are likely to be adopted in view of the resulting profit.

mologists in the Archipelago were Uichanco at Los Baños and Otones and Banks at Manila.

Recently I learned from a University of California publication that Alonzo W. Lopez (University of California class of 1928) is now Entomologist to the Philippine Sugar Association Research Bureau and is stationed at La Carlota, Occidental Negros, and that he has a good laboratory.

HAWAII

In 1893, the year before the Republic of Hawaii was definitely established, the provisional Government created a Department of Agriculture and Forestry, and Albert Koebele was appointed Entomological Expert for a term of three years. Mr. Koebele was charged with the duty of first carefully investigating the entomology of Hawaii and then of traveling in Australia, New Zealand, and other countries for the purpose of collecting and transmitting to Hawaii insects which will prey upon native and introduced insect pests. In the following years Koebele continued this work.

In 1898 the former Republic was annexed to the United States as a Territory. Soon afterwards an Agricultural Experiment Station, under the Office of Experiment Stations of the United States Department of Agriculture, was established, and D. L. Van Dine, a competent entomologist who had been educated at Cornell University, was placed in charge of the entomological work.

Under the Territorial Government, a competent inspection of introduced plants was begun at the port of Honolulu. Mr. Alexander Craw, well known for his previous work of a similar character in San Francisco, was placed in charge of this inspection.

The Hawaiian Sugar Planters' Association established a well equipped laboratory and appointed R. E. L. Perkins as Entomologist. Mr. Perkins was an Englishman who had been working in Hawaii under the auspices of the British Association for the Advancement of Science gathering material for the great "Fauna Hawaïiensis." His energies under the new appointment were largely devoted to the introduction of parasitic insects. He was given competent assistants. Mr. G. W. Kirkaldy, a well known British entomologist, was brought over. Albert Koebele was taken on, and the work under the Planters' Association assumed large proportions. Later Frederick Muir, a very well trained man and son-in-law of the famous Dr. David Sharp, joined the force; and later O. H. Swezey, D. T. Fullaway, F. X. Williams, H. S. Osborn, and other competent men were taken from the United States.

The circumstances connected with Swezey's appointment are interesting. Koebele had been instructed to find parasites of the sugar cane leaf-hopper. He came to Washington, knowing that I had a card catalogue of the host relations of the parasitic Hymenoptera, and asked me for some indication as to the parasites of leaf-hoppers known in different parts of the world. As it happened, a short time before, Mr. Swezey, then working at the Ohio Agricultural Experiment Station at Columbus, had studied a leaf-hopper parasite belonging to the Proctotrypoid family Dryinidae, and I told Koebele that he should go to Columbus and talk with Swezey. He did so, and offered Swezey a place in Hawaii which he accepted. Since that time he has proved to be one of the very best men in the service of the Sugar Planters' Association, and has remained there all these years.

Following the death of Alexander Craw, E. M. Ehrhorn, who had succeeded him in the inspection work at the port of San Francisco, again succeeded him in Hawaii and has since remained in Honolulu.

After the appearance of the Mediterranean fruit-fly in Hawaii and its rapid spread over the islands, it became very important to protect California against its possible introduction from that source. Consequently Dr. E. A. Back, a trained entomologist from the Massachusetts Agricultural College, was sent over by the Federal Horticultural Board of the United States Department of Agriculture and remained in Honolulu five years studying this insect and inspecting all shipments of fruit destined for United States ports. He was succeeded in 1918 by H. F. Willard, who is still engaged in this work, assisted since 1926 by A. C. Mason, a well-trained entomologist.

All of the insect pests of agriculture in Hawaii have been introduced accidentally. The mild and changeless climate of the islands and the fact that they are islands render parasite importation more effective than elsewhere. Therefore much work of this kind of very striking value has been done, practically entirely under the auspices of the Sugar Planters' Association. The extraordinary results of some of these importations will be described in another chapter, but this is the place to state that the wonderful results reached by the entomologists employed by the Association have been very gratefully appreciated and the men engaged have been not only amply compensated during their active work but also cared for in a princely way when they have been forced by ill health to retire. Koebele went back to Germany on full salary, remaining there until his death in 1924. R. C. L. Perkins was retired on full salary in 1913 and is still living, in England. Frederick Muir was also retired on full salary a short time ago, and has gone to England to live.

The far-sighted and liberal policy of the Sugar Planters' Association must be accredited to the organization as a whole, but I have a conviction that Mr. Walter M. Giffard, for many years the Secretary of the Association, was the prime mover and the impelling force of the policy established at such an early date. I believe that Mr. Giffard's interest in entomology was first aroused by R. C. L. Perkins. He became deeply interested in the whole subject and has done taxonomic work of value in the leaf-hopper family.

With conditions so unusual and so favorable to entomological study, and with a group of men so exceptionally fitted and working in a climate that is one of the most agreeable in the world, it is not surprising that admirable work has been done. An Entomological Society of Hawaii was founded in 1905 and it has published its proceedings which in many ways are the most interesting records of any entomological society in the world.

I visited Honolulu in 1915, largely for the purpose of looking into the conditions resulting from the importation of parasites of the sugar cane leaf-hopper and of the sugar cane borer. The results reported had seemed so delightfully perfect that I wished to study the situation. My observations confirmed everything that had been written about the work, and it is no wonder that the Hawaiian people rely very greatly upon imported beneficial insects.

In 1924 I revisited the islands, as Chairman of the First Pan-Pacific Conservation Congress. Entomologists from different countries bordering on the Pacific were present, and there were very interesting sessions of that particular section. The Congress as a whole considered very many matters, and there were present leaders in agriculture in all of its departments, representing many countries. The Congress in general passed many important resolutions, one of them relating to the necessity of establishing crop pest investigations in all Pacific countries and the organization of a central bureau to correlate results.

The conference of 1924 was largely attended, as I have said. It was in session for nearly three weeks, and there was a public luncheon or dinner, or both, almost every day. Honolulu is a very cosmopolitan town, and the national groups took turns in entertaining the Congress. It soon appeared that Sir Joseph Carruthers, a prominent delegate from Australia, was a very happy after-dinner speaker. He had a keen sense of humor, and, since I was the chairman of the conference, the two of us were asked to speak after almost every function. We, naturally, exchanged humorous compliments and gave each other mild digs.

The climax of this interchange of somewhat dubious compliments came at the final dinner, which was given by the Chinese community of Honolulu. The President of that community was Mr. Wang How, who made the opening address in the Chinese language. The toast-master was Mr. Charlie Wang, a Harvard graduate, who interpreted Mr. Wang How's speech. And then I was called upon, as chairman of the conference, to speak for the guests. I paid many compliments to the Chinese nation, said that I had been very much impressed by Mr. Wang How's speech, and stated that he had shown me that the Chinese were great inventors, not only in big things like the mariner's compass and gun-powder, but also in little things, since his name *How* was evidently the beginning of my own name and that upon the Chinese *How* some Englishman, perhaps a thousand years later, had drafted the *ard*. So I greeted Mr. Wang How as a long-lost cousin.

After a few moments of attempted pleasantries of that kind, I took my seat, and Sir Joseph was called upon. With his broad Australian accent, he remarked that he had been very much interested in what Doctor Howard had said but that he had anticipated him in the relationship to Mr. Wang How, since he had noticed the facial resemblance between the two men as soon as they had sat at table!

In an earlier paragraph we have referred to the appointment of D. L. Van Dine as the first Entomologist to the Agricultural Experiment Station founded by the Office of Experiment Stations of the United States Department of Agriculture soon after the annexation of the Hawaiian Republic to the United States as a Territory. Mr. Van Dine was appointed in 1902 and held the office until March, 1909. His first bulletin related to mosquitoes, and his interest in mosquitoes in Hawaii continued. He published three bulletins on the subject. It was this work that eventually led to his appointment in charge of a station under the Federal Bureau at Mound, Louisiana, in which very important research was carried on relating to malarial mosquitoes and to the economic effect of malaria on the laborers on a large plantation in the Mississippi delta. He also published while in Hawaii on a number of other insect problems, writing 13 special bulletins and contributing articles to the Report of the Station. He wrote one bulletin on the insect enemies of tobacco in Hawaii. It was published in 1905. For a number of years there was a strong effort to establish a tobacco-growing industry in Hawaii, but it was found impossible to grow wrapper leaf which would compete in price with that grown in the United States, and the attempt was abandoned. Insect enemies were a part, but a small part.

In 1908 Mr. Van Dine was brought to the United States, and D. T. Fullaway was appointed Entomologist to the Experiment Station. He held this post until June 30, 1915, when he resigned to take a post connected with the Territorial Board of Agriculture. While with the Station, he published a number of papers, including one on the insects injurious to tobacco and another on insects affecting cotton. The cotton industry started with good prospects in Hawaii, but the accidental introduction of the pink bollworm wiped it out. Since 1915 Mr. Fullaway has remained with the Territorial Board of Agriculture and has done admirable work. His place with the United States Experiment Station was not filled, since it was thought that, with the officials of the Territorial Board of Agriculture, the resident entomologists from the Federal Bureau of Agriculture, and those of the Hawaiian Sugar Planters' Association, there were quite enough entomologists employed officially in the islands to handle all of the insect problems.

An account of Hawaiian economic entomology would not be complete without mention of the investigations made by Mr. August Busck, of the United States Bureau of Entomology, who went to Hawaii in 1915 to study the pink bollworm of cotton. This extremely injurious insect had been discovered in Mexico, and the United States was threatened. It had also been accidentally imported into Hawaii and had virtually put a stop to experiments in cotton culture which were assuming considerable importance. Mr. Busck remained in the islands six months (May to October) and on his return to the United States published, in the *Journal of Agricultural Research* of the United States Department of Agriculture (Vol. 9, No. 10, June 4, 1917) the most complete study of this insect that has been made. The article considers the insect from all points of view, is illustrated with a number of careful figures, and has no less than 12 plates. Mr. Busck's great knowledge as a student of the Microlepidoptera assures the accuracy and importance of this very careful article, which, by the way, is accompanied by a full bibliography.

FIJI

The Fiji Islands have been utilized by the British very successfully in an agricultural way for many years. The great Colonial Sugar Refining Company has founded there very considerable interests, which, however, extend out into Australia and New Zealand.

In 1913 Mr. F. P. Jepson, who was then Government Entomologist of Fiji, made his importation of 5,000 Histerid beetles (*Plaesius javanus*) to destroy the banana weevil. He is said also to have brought

in the Agromyzid fly against the Latana weed as well as a Spalangia against the house fly. I have an idea that he left Fiji, at least temporarily, since Mr. Robert Veitch was appointed Entomologist of the colony in 1914. However, the Report of the Division of Entomology in the Annual Report of the Fiji Department of Agriculture for 1919 was signed by F. P. Jepson and C. H. Knowles.

Mr. Robert Veitch landed in Fiji in August, 1914. On his way out from England, he visited the United States and Hawaii, spending three months on the journey and visiting some of the important entomological stations on the way. He remained in the service about 11 years, but his work was not confined entirely to the Crown Colony of Fiji, since in 1917 he spent some months in Hawaii and also some months in the sugar cane districts of Queensland and New South Wales. He did a great deal of excellent work during these 11 years and published five illustrated reports dealing with the commoner insects associated with the sugar cane plantations, including the sugar cane beetle borer, wireworms, white grubs, hornets, and minor pests of the crop. He further published other articles in different journals.

Mr. Veitch became interested at an early date in the subject of biological control. This subject had attracted some attention in Fiji before his arrival; and in fact, when Frederick Muir, on his way from New Guinea to Hawaii, left there a small colony of the Tachinid parasite (*Ceromasia sphenophori*) of the sugar cane borer, the colony died out, and in 1912, 1913, and 1917 further colonies were introduced; and from the time of Mr. Veitch's arrival great efforts were made to establish this particular parasite. Twelve of the Company's officers were engaged in breeding the parasite at various centers. For a long time failure was feared, but by 1921 the percentage of borer-infested stalks had been very considerably reduced, the percentage dropping from 22 to 4 per cent. Mr. Veitch, however, does not think that this result can be laid entirely to the parasite, and he so stated in his report read at the Pan Pacific Food Conservation Congress in Hawaii in 1924.

Mr. Hubert W. Simmonds joined the force of entomologists in 1919 and went to Tahiti for parasites of the coconut scale (*Aspidiotus destructor*).

The so-called Levuana caterpillar, feeding upon the foliage of coconut trees, had become so destructive in 1922 and 1923 that a systematic effort was made to find natural enemies, and in 1923 Mr. Simmonds visited a number of Pacific islands, searching for the original home of the Levuana, but unsuccessfully.

In the meantime it was known as early as 1904 that there existed in Malaya a Lepidopterous insect known as *Artona catoxantha*, and in 1914 H. C. Pratt had published a statement that 20 per cent of the caterpillars were parasitized by a Tachinid fly. It was not, however, until 1924 that it was found that not only was this Tachinid the most important parasite of *Artona* but that it was possible to breed it on other caterpillars. The Fiji experts greeted this announcement with great interest. An account of what happened is published in an article entitled "Further Remarks on *Ptychomyia remota*, a Parasite of *Artona catoxantha*," by B. A. R. Gater, in the Malayan Agricultural Journal, Volume 14, 1926. Mr. Gater states that the first attempts to carry the parasite to Fiji were made by A. M. Lea of South Australia. He took a shipment of puparia on ice in early 1925, but all died on the way. In the same year Mr. Hubert W. Simmonds and Mr. C. H. H. Taylor went from Fiji to Malaya and, by most ingenious methods, succeeded in landing 300 living Tachinids that immediately laid eggs on *Levuana* larvae in Fiji.

In the meantime Mr. Veitch had gone to Queensland to accept an appointment, and his important work there has been considered in another place. He was succeeded in 1924 in Fiji by Mr. J. D. Tothill, a Canadian expert, who had done some work for Canada in the Gipsy Moth Parasite Laboratory at Melrose Highlands, Massachusetts. A great deal of very interesting work, largely concerned with the importation of different parasites, was accomplished by Mr. Tothill and his very able assistants, Messrs. Simmonds and Taylor.

Mr. Tothill was later promoted to the position of Superintendent of Agriculture, and in 1929 was transferred to Uganda as Director of Agriculture. He was succeeded as Government Entomologist in Fiji by Mr. Hubert W. Simmonds.

Aside from this work, the Empire Cotton Growing Corporation employed an expert on cotton insects in Fiji, Mr. R. R. Anson, who in 1928 published a report in which he wrote about pink bollworm, one of the cotton stainers of the genus *Dysdercus*, one of the so-called tipworms (*Earias fabia*) and also a fruit-fly that infests cotton bolls.

The Fiji entomologists have done a great deal of traveling, not only to other South Pacific islands and to Malaya and the Dutch East Indies, but on two occasions to the British West Indies and British Guiana and to New Guinea.

Mr. Simmonds, the present Government Entomologist, has been devoting much attention of late to the banana borer and has met with considerable success by using a vacuum fumigator and by prolonged partial immersion in water.

While Mr. Simmonds is the Government Entomologist, Mr. R. W. Paine and Mr. T. H. C. Taylor are the entomologists of the so-called Coconut Committee.

Prof. T. D. A. Cockerell, of Colorado, visited Fiji in 1928, and in an article published in the journal *Science* for December 7, 1928, mentioned incidentally that the entomological work in Fiji was supported to the extent of about one-half by the Government; the other half by the planters, through a tax on copra.

SAMOA

Several American entomologists have visited Samoa since the United States became interested in those islands, and before the World War German experts working in German Samoa conducted a number of investigations, the most notable being that of Dr. F. Friedrichs on the coconut beetle. In 1926 G. E. Hopkins, of England, made a study of the pests of economic plants in Samoa and other island groups. He seems to have worked with Dr. P. A. Buxton who was sent out there from England and who reported on the human disease problems, especially the diseases carried by insects. Later Doctor Buxton became connected with the London School of Tropical Medicine, and is the medical entomologist of that institution.

GUAM

An Agricultural Experiment Station was established in Guam under the Office of Experiment Stations of the United States Department of Agriculture early in the present century. From May 16 to November 3, 1911, Mr. D. T. Fullaway made extensive collections on the island and published notes on some of them in the Report of the Guam Station for that year.

In 1925 Mr. S. R. Vandenburg was appointed Entomologist to the Station, and has published several reports. He has been especially interested in the control of the coconut scale by biological means, and has been very successful. He has also established in Guam the Tachinid parasite (*Ceromasia*) for the sugar cane borer.

PART VI

SOUTH AND CENTRAL AMERICA AND THE WEST
INDIES

ARGENTINA

The Republic of Argentina was fortunate in having for many years, as a resident of Buenos Aires and as Director of the National Museum, Dr. Hermann Burmeister, the author of the famous "Handbuch der Entomologie."

The ravages of migratory locusts in several countries of South America have attracted great attention, and Argentina, like several of the other countries, has formed from time to time commissions of investigation. Doctor Burmeister devoted most of his time to the study of paleontology and to the building up of a general museum, but he also made large collections of insects and at a comparatively early date studied the migratory locust problem. In 1861, his "Reise durch die Plata Staaten," a two-volume work published in Halle, summarized previous writings upon locusts in Argentina and gave a rather full account of the life history of the insect and of the damage that it had done almost annually.

The real beginnings of both systematic and economic entomology in Argentina, however, date from 1873. In that year the first Entomological Society in the country was founded, and a year later the Sociedad Científica Argentina was started and the Science Academy in Cordoba began the publication of its Annals.

In 1897 a governmental locust commission was established, entitled *Comision para la Extincion la Langosta*. This was the immediate predecessor of the *Defensa Agricola* which still exists and is the organization for fighting the insect and other enemies of agriculture.

Prior to the establishment of the locust commission, two German employees of the Argentine Government, Dr. H. Weyenbergh and Dr. E. Oldendorff, investigated and reported upon injurious locusts during those years.

In 1897 the United States Department of Agriculture was appealed to to nominate an entomologist especially skilled in the study of destructive locusts. Prof. Lawrence Bruner, of the University of Nebraska, who had been connected with the work of the United States Entomological Commission against the Rocky Mountain locust and who had later made survey journeys to note locust conditions for the Department of Agriculture, was nominated and went to Argentina where he carried on investigations for some time and submitted a very good report which was published in March, 1898.

In the 1890's the famous French entomologist, J. Künckel d'Herculais, had made an exhaustive study of the migratory locusts of Algeria and subsequently the French colonial government published the results of his investigations in four volumes, 1893-1905.¹ Künckel d'Herculais was a thoroughly skilled orthopterist and a man of pronounced practical views; and he also was invited by the Argentine Government to investigate their locust problem. This he did and a short report by him was published in 1900.

The *Defensa Agricola* has done good work, and its machinery is simple. I am indebted to Mr. Everard Blanchard for the following facts.

The country is divided up into 33 geographical divisions, each division being called a "seccional." Each seccional is provided with a chief, or "comisario," who has charge of as many men as the importance of his division warrants. The farmers included in each division report their insect troubles to the comisarios or to the personnel in their charge, and these in their turn advise the farmers how to attack the pests, and, when necessary, provide spraying machinery or other implements required to combat the pest. For locust work, the *Defensa Agricola* has a stock of over 50,000,000 meters of zinc and galvanized iron sheeting, conveniently distributed in 43 depots. As a rule this sheeting is rented to the farmers at a very low rate, but in case the farmer is poor and unable to pay rent, the sheeting is provided gratis. When the pest reported to the comisario is a new one, or presents unusual characteristics, the matter is referred to the central office in Buenos Aires, material of the pest or disease being sent to the *Defensa's* laboratories to be studied. If the pest is of sufficient importance, competent entomologists or agronomists are sent to study the plague on the spot. Otherwise, after due identification of the pest, detailed information is sent to the comisarios who in their turn advise the farmers and cooperate, when necessary, to carry out the

¹ I do not think the story has been told in print of the report that was sent out from Paris over the world during Künckel d'Herculais' work in Algeria. It was stated that he had been devoured by a swarm of locusts and so completely devoured that nothing was left but a part of his red necktie. The story was believed in many scientific circles; obituaries were written, and laudatory addresses were given at several scientific societies (the Entomological Society of Washington among others). The story, however, proved to be imaginary, and I saw Künckel later many times in France, on one occasion at a dinner at the late Alfred Giard's. Künckel was asked to tell the real story. He replied that there was no real story, but that he was immensely gratified on his return to France to read the laudatory things that had been said about him under the supposition that he had died so tragically.

destructive measures indicated by the central department. There are certain pests that have been decreed as such by law. The destruction of these is obligatory, and detailed control measures have been published and freely distributed.

The study of the natural enemies of insect pests in this country has been carried out for the last 30 years, since 1897, when Bruner and d'Herculais studied the possibility of combating the "langosta" by means of its natural enemies. Since then three efforts have been made to establish natural enemies—*Prospaltella berlesei*, to combat the white peach scale; *Parexorida caridei* for the control of the bagworm, and *Aphelinus mali* for the control of the woolly aphis. The last mentioned parasite had been established with great success—as much cannot be said for the first two. Lately efforts are being made to establish the South African parasite of the Eucalyptus weevil (*Gonipterus gibberus*), but nothing can be said as yet as to the results. The Argentine has also played her part in supplying natural enemies to the rest of the world, the most successful results being obtained from a shipment of *Cactoblastis bucyrus* to Australia to aid in the eradication of the cactus pest. As regards methods of spraying and implements used, most of the formulae and machinery are those that have been tried out in other countries, especially in the United States, which is considered to lead the world in that line of endeavor. Power sprayers are practically all of American manufacture, but the smaller types of knapsack sprayer are mostly French, Vermorel. This is not because the French article is superior but because it is considerably cheaper and gives equal results. Aeroplane dusting has not been definitely adopted in Argentina, although several official trials have been made with this method of insecticide distribution. Official production of insecticides has so far been restricted to lime-sulphur, which is sold at cost price to the fruit-growers of the country.

In the earlier days, Carlos Berg, a well known entomologist published on Argentine insects from 1874 to 1895, and among his writings are several papers of economic importance, particularly those relating to the Phylloxera of the grape.

There is a paper on the bibliography of Argentine entomology, published in *Physis*, November 15, 1927, by C. A. Lizer y Trelles. Under Applied Entomology, he gives 347 titles. The most prolific writer seems to have been H. Weyenbergh, to whom we have already referred. He published from 1873 to 1876, mainly concerning locusts. Between 1901 and 1909 several papers on scale insects were published by Eugenio Autran. Carlos Berg, a well known entomologist,

who succeeded Burmeister in the National Museum, published several economic papers between 1874 and 1895, the most important ones relating to the Phylloxera.

One of the most prolific writers on Argentine insects was the late J. Brêthes who died recently. His papers were in the main taxonomic but he wrote several that were concerned with injurious insects and were published between 1899 and the time of his death in 1928. The author of the bibliographical list, C. A. Lizer y Trelles, lists several titles of papers of his own. And the well known naturalist, L. Iches, also published a few articles of economic bearing, notably one on the plague of *Stomoxys calcitrans* which did great damage to cattle following the neglect for a time of an ordinance requiring the destruction of old straw stacks.

Then also, José M. Huergo, between 1905 and 1923, published a number of short articles relating to injurious insects, especially scale insects. Before that, E. Lynch Arribalzaga published several papers of economic purpose, the first on locusts in 1891.

A younger man, Carlos S. Reed, a son, by the way, of Edwyn C. Reed of Chile (the latter an Englishman who lived for many years in Chile and died there) has written many shorter articles relating to Argentine insects, from 1910 on.

During the present century occasional entomological articles of value have been published in the *Gaceta Rural* of Buenos Aires. I have especially noticed one on the Peach Fly (*Chyliza persicarum*) by José C. Castellano, which seems to be thorough and excellent.

Carlos Lizer has written a number of sound articles in comparatively recent years, published for the most part in *Agronomía*. He has especially interested himself in scale insects.

The Bulletin of the Ministry of Agriculture for 1916 contains entomological articles by E. Molina and P. T. Canela, and in this Bulletin the interesting statement is made that during the month of October, 1916, 1,425,864 pounds of locusts were destroyed; 9,275 ants' nests; and 34.025 pounds of bagworms.

Another writer has been Dr. P. C. Massini, who has contributed to the *Annals of the Rural Society of Argentina*. This Rural Society, by the way, has had an Entomological Section, and Doctor Massini has written in the *Annals* on the general subject of biological control of injurious insects.

A late publication of the Ministry of Agriculture was written by E. E. Blanchard, on the subject of insects affecting *mate*. It was published as Circular 735 of the Ministry of Agriculture in 1928. It covers 42 pages and contains three figures and four plates.

A. H. Rosenfeld, an entomologist from the United States, was employed for a time by a sugar organization in the Argentine, and wrote several papers. E. W. Rust, another North American entomologist, was for a time in the Argentine, and also wrote several papers of an economic bearing.

I regret that I have never had the opportunity to visit Argentina. Mr. G. F. Moznette, of the Federal Bureau, and Mr. Max Kisliuk, Jr., working with the plant quarantine service of the United States Department of Agriculture, have both visited that country in recent years and have told me of their cordial reception and of the excellent character of the work being carried on. Both speak very pleasantly of Prof. Fernando Lahille, Chief of the Zoological Laboratory of the Ministry of Agriculture, who was also at that time President of the Entomological Society of Buenos Aires. Both met Everard E. Blanchard, connected with the Argentine service, who was a graduate of the Maine State Agricultural College.

BRAZIL

While Brazil began to have an appreciation of certain branches of science at an early date, very little was done in entomology, and especially in economic entomology, until comparatively recently. Many naturalists visited Brazil in the last century, and enormous collections of one kind or another were sent to the great museums of Europe. Humboldt's writings were widely read and everywhere appreciated. William Henry Edwards, an American entomologist, visited the valley of the Amazon and published a charming book about his observations as early as 1847, and it is interesting to note that Alfred Russell Wallace and H. W. Bates were so much interested by this book that it was the principal incentive that started them on their famous journeyings in the same region.

Among the many collectors of natural history specimens who visited Brazil in the ensuing years, Herbert H. Smith may be especially mentioned. He originally visited the country on one of the early expeditions of Charles Fred Hartt, the first Professor of Geology at Cornell University, and the results of his collecting were incorporated in the collections of the Department of Entomology at Cornell. Later he visited Brazil many times. I believe that the Pittsburgh Museum contains the bulk of his material. He was a wonderful collector and cared for his specimens in a very perfect way. His work in this direction ranks with that of the later work of Albert Koebele and Carl F. Baker.

During the reign of the Emperor Dom Pedro II, the country awakened to an appreciation of applied science, and many students were sent to the United States to study engineering and other branches.

Possibly the earliest investigation in economic entomology was made in 1870 when B. Pickman Mann, of Cambridge, was sent to Brazil with personal letters of introduction to Dom Pedro from Louis Agassiz. He was given a commission to investigate the zoology, entomology, and botany of Brazil. He selected his own field of work, studied coffee and maize insects for five months and prepared a report on each topic. I do not know that these reports were ever published by the Brazilian Department of Agriculture, but Mr. Mann, after his return to the United States, published in the American Naturalist an interesting account of some of his observations upon coffee insects.

In 1880, John C. Branner, afterwards famous as a geologist and who succeeded David Starr Jordan as President of Stanford University, was sent to Brazil by the United States Department of Agriculture, largely to investigate the occurrence in that country of the famous cotton moth (*Alabama argillacea*). He was accompanied by Albert Koebele. On his return he prepared two reports. The first was entitled "Preliminary Report of Observations upon Insects Injurious to Cotton, Orange, and Sugar Cane in Brazil." It appeared on pages 63-69 of Bulletin No. 4, Division of Entomology, United States Department of Agriculture, 1884. The second was entitled "Cotton Caterpillars in Brazil," and was published in the Fourth Report of the United States Entomological Commission (1885). From this expedition Koebele brought back a very interesting collection of insects of economic importance including very many Hymenopterous parasites which he reared from the different cotton caterpillars.

In 1880, Dr. Hermann von Ihring, a German by birth, and a zoologist of broad accomplishments, at the age of 30 left a position in Leipzig and went to Brazil. After various experiences he became head of the Natural History Museum in Sao Paulo and started early work in economic entomology, publishing at the same time papers in other departments of zoology. His son, Rudolfo, acted as his assistant and published several joint papers with his father. During the World War, like all other Germans in government employ, the elder Von Ihring was discharged, and in 1920 went back to Germany where he died February 24, 1930, at the age of 79. While in Brazil, he had as early as 1882 begun to study the leaf-cutting ants, and he published a somewhat extensive paper on this subject in 1894. In 1898 he published a study on the injurious insects of the Jabota tree. Later

he published papers on insects injurious to the orange, to cotton and to the fig tree. In 1909 he worked on the wood-boring larvae injuring cultivated trees.

The son, Rudolfo, published a rather long list of entomological papers over his own signature, a number of them of an economic character.

In 1885, a Swiss, Dr. E. A. Goeldi, who at the time was Curator of Zoology in the National Museum at Rio de Janeiro but who had been previously a Phylloxera expert in Switzerland, was commissioned to study coffee-tree diseases. He prepared a detailed report which was published in the Archives of the Museum. He was also sent to Sao Paulo to study the viticultural interests of that State, and especially to report upon the danger from the Phylloxera. He published a book entitled "American Vines," advocating the introduction of American root stock. This book, I believe, was published privately. In 1890 he left Rio and became the Director of the Museum of Natural History at Para.

With the discoveries at the end of the last century in regard to the relations of mosquitoes to disease, Brazil became very active. Goeldi published a large work on the mosquitoes of Para; Adolfo Lutz, a German, resident in the State of Sao Paulo, published important papers on mosquito-borne disease; Oswaldo Cruz started a hygienic institute in Rio, secured funds, brought together an able corps of assistants, and, with the adequate support of the Government, succeeded in practically wiping out yellow fever at an early date. Cruz visited the United States during these critical years, and later in 1910, sent one of his experts, Dr. Arturo Neiva, to Washington to study mosquitoes here for several months. Neiva also studied the biting Hemiptera of the genus *Triatoma*, and, before returning to Brazil, pursued his studies of this group in European museums.¹ One

¹ Doctor Cruz told me that the experts in the Hygienic Institute in Rio at the expiration of a certain length of time were allowed a year to study abroad. They usually went to Europe. He was so impressed by what he saw in Washington that he suggested to Doctor Neiva that when his turn for travel should come he should visit the United States. Doctor Neiva at that time was a charming man of 30 years, primarily perhaps a bacteriologist, but tremendously interested in medical entomology. He remained in Washington for several months. Not long after his return to Brazil, he accepted an invitation from the Government of Argentina to found in that country a Department of Medical Zoology and Parasitology. He remained in Argentina 18 months in 1914, 1915, and 1916, and then returned to Brazil where he has done extremely important work and has assumed important responsibilities, largely with matters relating to health. He took a hand, however, in the work of the commission to investi-

of the *Triatomas* had, by the way, been found responsible for the transfer of Chagas's disease in Brazil. The Oswaldo Cruz Institute gained a very high place at an early date, and has since maintained it. Its publications are printed in both Portuguese and English and are highly esteemed in medical centers.

Organized Government efforts to control plant pests did not exist until 1910, and in fact there was no Government department of agriculture. Prior to that time, on the appearance of some notable pest, some museum or botanic garden specialist was detailed to study it. In 1910, however, the Federal Department of Agriculture was founded, and two laboratories were started in the National Museum, one for research in economic entomology and the other for phytopathology.

In 1920, under the Ministry of Agriculture, there was created a Biological Institute for Agricultural Defense (*Instituto Biologico de Defesa Agricola*). The laboratories of economic entomology and phytopathology were transferred from the National Museum to the new Institute, and there was added later a third section entitled Plant Inspection Police (*Vigilancia Sanitaria Vegetal*). I am informed that this institute has a good library and a very good laboratory with the necessary facilities, and very considerable collections. The plant-inspection system has a principal station at the port of Rio de Janeiro, and also has stations along the Brazilian coast, where plant inspections are permitted. These stations are Manaus, Belem, Recife, Bahia, Santos, S. Francisco, Rio Grande, Porto Alabre, and Corumba.

The Institute publishes bulletins when the occasion arises, and, although not largely manned, has a competent staff. Prof. Carlos Moreira, in charge of the entomological work, is a very good officer. He visited the United States in the spring of 1918 and looked into the work of the Federal Bureau of Entomology. In 1923 I had the pleasure of meeting him again at the International Conference of Economic Entomologists and Phytopathologists at Wageningen, Holland.

The bulletins published by the Institute are very well done. The first one published (in 1921) was entitled "Brazilian Agricultural Entomology" (*Entomologia Agricola Brasileira*), by Professor Moreira. It is a well illustrated book of 182 pages.¹ The second bulletin

gate the ravages caused by the coffee berry moth. Also he has made several visits to Argentina. Among other notable results of these visits have been the verification by him of the existence of Leishmaniasis and exanthematic typhus in that country.

¹ A second edition of this valuable bulletin was published in 1929. This second edition is enlarged to 274 pages and has many new illustrations. It includes the new pests discovered between 1921 and 1929.

was published in 1925 and relates to the plant-lice of Brazil, also by Professor Moreira. Bulletin 3, published the same year, relates to the coffee borer; No. 4, to the leaf-hopper enemy of sugar cane—both of these by Professor Moreira. No. 5 relates to phytopathological work.

Adolph Hempel, born in the United States and educated at Rawlins College, Florida, and at the University of Illinois, went to Brazil in the closing years of the last century and became an assistant to H. von Ihring at the Museu Paulista. He began at once to study scale insects, and published a number of important papers on this group in the *Annals and Magazine of Natural History of England* for the year 1901. The previous year (1900) he had published a lengthy paper on the Coccids of Brazil in the *Revista do Museu Paulista*. In 1910 he published at Sao Paulo a catalogue of the Coccidae of Brazil which includes descriptions of new species. Later he was appointed to the Agronomical Institute at Campinas and held a position equivalent to that of a State Entomologist at an experiment station in this country. He taught in entomology and vegetable pathology, and remained there until 1902 or 1903. On giving up his work at Campinas, he went back to Sao Paulo and was appointed State Entomologist of that State; and in this capacity he investigated various crop insects, including the enemies of coffee. One of the important tasks that he undertook was a revision of the family Aleyrodidae. I am informed by his brother-in-law, Mr. F. L. Lewton, of the United States National Museum, that on January 20, 1929, he sailed for Uganda to search for parasites of the coffee borer, and expected to be gone three or four months.

In the (translated) Archives of the Superior School of Agriculture and Veterinary Medicine, Rio de Janeiro, Volume 8 (1927), there is a tentative bibliography of Brazilian entomology which covers about 600 titles of papers written mainly by Brazilians but including a few by foreigners relating to Brazilian insects that had been sent to them, as for example, the Italian Bezzi on Diptera, and the American Cockerell on Coccidae. This bibliography is prefaced by a list of the injurious insects of Brazil, which runs to 864 numbers. This list and bibliography were prepared by Dr. A. da Costa Lima, a younger man who has been doing admirable work for the past 15 years. While perhaps most of his papers have referred to medical entomology, he has written a number on agricultural entomology. He has studied fruit-flies and Curculionid beetles as well as the parasites of a number of injurious species. In fact his main work seems to have been of an economic character. The first paper of his listed (1914) is entitled

(translated) "Contribution to the Study of the Culicidae: Observations on the Respiration of the Larvae." The very destructive outbreak of the coffee borer (*Stephanoderes coffeae*) in the early 1920's started him to work on this, and a number of his later papers have been written on this subject. For example, an important article by B. de Toledo Rodovalho was published in 1925, and other articles by other writers have been appearing from time to time.

The coffee-borer damage resulted in the establishment of a Government commission of investigation with, I believe, Dr. Arturo Neiva as chief, and a number of the best men in Brazil have been engaged in the investigation. Professor da Costa Lima's last letter to me was written from the Instituto Oswaldo Cruz rather than from the Superior School of Agriculture and Veterinary Medicine which had been his earlier address.

Another of the younger men who are doing admirable work in Brazil is Gregorio Bondar. It appears that in 1913 he was connected with the agricultural school "Luiz de Queiroz" at Piracicaba in the State of Sao Paulo. In that year he published two parts of a series entitled (translated) "The Insects Injurious to Agriculture." The first part considered the insect enemies of the cultivated fig. It is a pamphlet of 17 pages, with 13 figures. The second part considered the enemies of Myrtaceous fruits. This is a larger pamphlet, covering 39 pages, and is illustrated with 31 figures. Parts III and IV are indicated on the cover leaf of Part II, but I have not seen them. They include the enemies of the orange and other Citrus fruits, in Part III; and, in Part IV, some enemies of fruit culture and arboriculture.

Sometime between 1913 and 1922, Bondar was made Entomologist to the Ministry of Agriculture of the State of Bahia, and in the latter year he published, under this Ministry, a pamphlet of 111 pages on the enemies of the coco-palm. As usual, this pamphlet was well illustrated, with 73 plates and text figures.

In 1923 he published, under the same Ministry, an important paper of 182 pages with 84 figures, entitled "The Aleyrodidae of Brazil." Although in a subtitle he called it a descriptive catalogue, it is rather more than that and is very full and very carefully done and contains a general statement regarding the morphology of the group.

In the same year he published, in the Revista do Museo Paulista, a short account of some Brazilian Buprestidae.

In 1925 was published Part II of what is evidently a series of papers on cacao, this part including the diseases and enemies of cacao plantations. This is a pamphlet of 125 pages, and is illustrated by 74 original figures.

In 1928, in the *Correio Agricola*, there appeared an article from his pen, on the coco-beetle.

In 1929 he published a pamphlet entitled "The Culture of Oranges in Brazil," a work of 138 pages with 63 illustrations. The diseases and injurious insects are considered in this pamphlet; and Part II, covering pages 79 to 126, is devoted to insects and mites.

Between 1924 and 1929 he published, under the auspices of the Bahia Ministry of Agriculture, six numbers of an important Bulletin of the Laboratory of Plant Pathology of Bahia in which he has dealt with a number of different topics, including very many of an entomological character.

Aside from the work done at Rio de Janeiro and in the States of Sao Paulo and Bahia, there is practically no Government or State work done in economic entomology. However, Dr. R. von Ihring informs me that in Rio Grande do Sul a periodical entitled "Egates" is issued by the Polytechnic High School in Porto Alegre in which occasionally original articles touching upon entomological science are published. Doctor von Ihring also informs me that economic bee culture is assisted in Rio Grande do Sul by a periodical which has been issued since 1897. The editor of the journal, E. Schenk, has published a handbook on bees, which has reached an eighth edition. I am also informed that the Benedictine, D. Amaro van Emelen, in Sao Paulo, is an authority on bees and that his learning regarding bees is recognized throughout Brazil.

An Agricultural College on North American lines has been established in the State of Minas Geraes with the organizing advice of Prof. P. H. Rolfs (formerly of Florida and originally an entomologist). The journal *Science* for November 29, 1929, states that E. J. Hambleton, B. S. (Ohio), M. S. (Cornell) has been placed in charge of entomology in the new institution.

Quite recently a publication has been started in Sao Paulo entitled (translated) "The Archives of the Biological Institute." The first number contains no less than three articles of economic entomological importance: one by H. Eggers, on the *Ipidae* of South America; another by M. Autuori, on a Phorid parasite of *Icerya purchasi*, and one by A. Hempel on some new *Coccidae*.

Among the Brazilian writers of late years we may mention J. Vizioli, J. S. Guimares, L. A. de Azevedo Marques, and A. F. M. Torres. Aside from economic entomology, the great work of Romualdo Ferreira d'Almeida on the *Rhopalocera* of Brazil should be mentioned. Senhor d'Almeida was given the Alcide d'Orbigny prize of the Entomological Society of France, for his work, in 1929.

URUGUAY

Uruguayan insects were collected at a comparatively early date, as indeed were those of all the accessible portions of South America. At one time the well known entomologist, Carlos Berg, was connected with the National Museum at Montevideo, but went to Buenos Aires where he eventually succeeded Burmeister; but Doctor Goding informs me that Berg always felt that Uruguay was a part of his field of operations even when he was in Argentina.

Uruguayan crops must have suffered from insect damage very many years ago. I notice, for example, that C. F. Girard, in the Bulletin of the Entomological Society of France for 1860, page 73, reports the occurrence of a blister beetle (*Epicauta conspersa*) as swarming by millions on sugar beet fields near Montevideo, completely destroying the crop which represented the first attempt to cultivate sugar beets in Uruguay. The adjoining fields of sorghum were said not to have been damaged by the beetles.

In the following years comparatively little seems to have been done in economic entomology in Uruguay until 1911. It is true that an agricultural laboratory existed in which some studies were made on insects injurious to certain crops by Juan Puig y Nattino, and the Agronomic Institute also carried on certain entomological studies.

In 1911, however, the "Defensa Agrícola" was instituted as a branch of the Ministry of Industry. Ing. Roberto Sundberg was appointed director, and this branch of the Government has done a great deal of work in economic entomology. It has been especially successful in the importation of beneficial insects from other parts of the world, and this highly important work will be described under Uruguay in our later section entitled "The Practical Use of Predatory and Parasitic Insects."

In 1925, a Department of Agronomy was created under the Ministry of Industry, and this department included a Division of Fomento and Defensa Agrícola, this division having charge of work with entomology and phytopathology. Doctor Sundberg has been made Chief of the Department. The Government, through this official machinery, has been very active in that country, and it is stated that its activities have practically rid the country of its most dangerous insect pests. The Defensa Agrícola has published many short papers and also large reports relating to locust outbreaks. In its monthly bulletin have appeared many articles relating to insects and their damage, by J. Bréthes, A. T. Peluffo, V. Giacomo, J. Molino, Roberto Sundberg, J. Girardi, and others.

In addition to the *Defensa Agrícola*, there is under the Ministry of Public Instruction a National Institute of Agronomy in which Mr. G. B. Schurman was Professor. Professor Schurman was active in many of the movements in applied entomology in Uruguay, and his comparatively recent death is greatly to be regretted. There is at present in the National Institute a Professor of Entomology, Agustín Trujillo Peluffo, and a Professor of Applied Zoology, Gilberto Borrás.

PARAGUAY

Economic entomology is comparatively new in this country. A good entomologist, Mr. A. de Winkelried Bertoni, began work upon the higher Hymenoptera nearly 20 years ago and published a long systematic paper entitled (translated) "A Contribution to the Biology of the Wasps and Bees of Paraguay." It was published in the *Annals of the Museum of Buenos Aires* in 1911. In 1917 he published a paper relating to the edible Lepidopterous larvae that feed upon certain species of bamboo. About 1923, there was created in the Ministry of Fomento a Section of Agriculture and Agricultural Protection ("Dirección de Agricultura y Defensa Agrícola"), and under this section there was a division headed by Señor Bertoni with the title Entomologist and Chief of the "Mesa Fitopatológica." Under this organization numerous bulletins have been published, a number of them relating to injurious insects and the remedies to be used. Especial attention has been paid to the insects injuring fruits, to those injuring cotton, to injurious ants, to the suppression of the migratory locust, and, under the Section of Chemistry, there has been an arrangement for the analyses of insecticide products.

ECUADOR

Very little has been done in economic entomology in Ecuador, although some interest has been taken in entomological matters for a long time. Medical entomology, however, has important applications there. Guayaquil was long notorious for yellow fever. After the yellow fever mosquito discoveries had been generally accepted throughout Latin America and it began to appear that it was possible to rid the world of this disease, one of the last and most difficult tasks was to clear up Guayaquil. The attention of the International Health Board and the United States Public Health Service was for a time focused to a certain extent on this city, and the results were very beneficial. The services of Dr. J. H. White of the United States Public Health Service, who had done such efficient anti-yellow-fever

work in New Orleans in 1905, were loaned to the International Health Board for this purpose.

Dr. F. W. Goding, of the United States, was Consul General at Guayaquil from 1913 to 1924. Doctor Goding is a trained entomologist, and at one time (before he entered the Consular Service) did some admirable entomological work in Illinois. In Guayaquil he made a number of interesting observations, and has written me a most interesting letter about the plague of crickets which comes on in Guayaquil within a day or two after the wet season begins. They enter the city in countless billions and are a frightful plague. He says that on one occasion, on the appearance of the crickets, thousands of sea gulls came inland to feed upon the insects, with such good effect that the plague was materially lessened both for that year and the following year. Thus this experience paralleled the old-time invasion of Salt Lake Valley by sea gulls in the early days of the Mormon settlement, to the great relief of the inhabitants whose crops were being eaten up by the so-called "Mormon cricket." In the Ecuador case the species seems to have been *Gryllus assimilis* Fabricius, a field cricket of very wide distribution.

For a number of years Prof. F. Campos R. has been State Zoologist of Ecuador. He is Professor of Natural Sciences in the National College of Vicente Rocafuerte. The published list of his principal scientific works comprises 82 titles, of which a number are entomological articles of economic importance, most of them relating to medical entomology, but some to agricultural entomology.

Some years ago Professor Campos collaborated with the Federal Horticultural Board of the United States Department of Agriculture in the study of tropical fruit insects. He is a very enthusiastic entomologist. Doctor Goding writes of him, "His whole life is wrapped up in entomology." His articles have been published mainly in the *Revista del Colegio Nacional Vicente Rocafuerte*, which is now in its 12th volume and is issued in "trimestral" parts. This seems to mean that three parts are published with each number, but the numbers themselves may cover irregular periods. Thus, the 10th volume includes January to December, 1928, incorporating Nos. 32 to 35; and the 11th volume runs from January to June, 1929, and includes Nos. 36 to 37. Professor Campos seems to be growing more energetic as the years pass by. I have received no less than 10 pamphlets from him that were published during the year 1929. One of these discusses the timely topic as to whether the Mediterranean fruit-fly exists in Ecuador.

I have seen references to several articles on economic insects published since 1926 by Ernesto Molestino O., of the Department of Agriculture, including one on a cane weevil (*Eumycterus? saccharidis*). These bulletins have been mimeographed, but so far as I know have not been otherwise published.

The (translated) Agricultural Association of Ecuador is an organization that has been in existence for quite a number of years. In 1918 this association issued a report on the diseases and pests of cacao by J. B. Rorer. The author considered ants, the cacao-beetle and a Capsid bug (*Monalonion atratum*). In 1920 and 1921 Mr. H. K. Plank, an American entomologist, was employed by planters' associations in Ecuador to make a study of cacao insects, and in a bulletin of the Agricultural Association in 1921 he published a practical article on the control of *Atta* sp. in the cacao plantations.

Professor Campos has been good enough to write me about the insect crop pests of Ecuador, and they seem to be rather numerous. All crops suffer occasionally from migratory locusts; and the coconut plantations, as well as the sugar cane, beans, coffee, peas, turnips, potatoes, cotton, Citrus trees, tomatoes, and others are rather seriously injured from time to time by different insects. The Government of Ecuador maintains, for agricultural investigation, two small experiment stations—one near the coast on the Island of Silva facing Guayaquil, and the other in the interior at a high elevation at Quinta Normal in the State of Ambato. In the field of agricultural entomology, however, no serious or important work has been done.

CHILE

As has been the case with most other countries of South America, the insect fauna of Chile was studied with more or less care many years before native entomologists began to write. Claudio Gay, an ambitious and indefatigable French entomologist (1800-1877), began to study Chilean insects as early as 1836, and after publishing some articles on the Coleoptera of Chile in the publications of the Entomological Society of France, he planned a great work entitled "Historia Física y Política de Chile." Volumes 4 to 7 of this great work included an account of the insects. His collections in the different orders were sent to well known European specialists, and he had the assistance of the following competent entomologists: H. Nicolet, P. Gervais, A. Solier, Émile Blanchard, and M. Spinola. The last volume was published in 1852, and the whole work was printed in Paris. The publication of this work was naturally the basis for future work on Chilean insects and an incentive to such work. In 1865,

R. A. Philippi published a list of Chilean Diptera in the *Verhandlung d'K.-K. Zool. Bot. Ges. of Vienna*. In 1886 a catalogue of the Chilean Lepidoptera was published at Santiago, and in 1887 F. Philippi (a son of R. A. Philippi, resident in Chile) published in the *Annals of the University of Chile*, Volume 71, a catalogue of the Coleoptera of Chile. It is interesting to note, as an indication of the advance of knowledge, that Gay's original list of Coleoptera comprised only 891 species, whereas Philippi's later list mentioned 2,247.

In 1869 an English naturalist, Edwyn C. Reed (born in Bristol, November 7, 1841; died in Concepcion, Chile, November 5, 1911) went to Chile and took a position as Entomologist in the National Museum. He built a small museum at Los Baños de Cauquenes in 1875, and in 1878 began the organization of a museum at Valparaiso. He then became Professor of Natural History and Physical Geography at the Military and Naval Academy, holding this position for seven-years and then, on account of his health, moved up into the mountains. In 1902 he was made Director of the Museum of Concepcion, where he worked until his death. Mr. Reed published many papers on entomology and corresponded with the Bureau of Entomology at Washington from 1893 until 1907. His work was very largely taxonomic, and only occasionally economic. In 1902 he published an article on the invasion of grasshoppers into Chile. This report was an official one, and at that time it was expected that a large appropriation for grasshopper work would be made. But the emergency passed.

In that year Mr. Reed sent a large collection of insects to the United States for exhibition in the Chilean department of the Buffalo Exposition. Through some misunderstanding, however, the collection was never exhibited at Buffalo, and it remained in New York during the period that the World's Fair was open. Eventually, through the courtesy of Don Enrique Budge, the chairman of the Chilean exhibition committee, it was forwarded to Washington where it was incorporated in the insect collections of the National Museum. It contains very many interesting forms. Among the many subjects in entomology that especially interested Mr. Reed was the very strange subterranean scale-insect genus *Margarodes*. He studied one of the Chilean species and published about it.

Before he arrived in Chile in 1869, Mr. Reed had spent five years in Brazil collecting and studying. He had three years of intermittent fever and a bad attack of yellow fever. He returned to England in 1868 badly broken down and was advised to take a long sea trip

and to settle down in a dry climate. And so he went to Chile, where he spent the rest of his useful life.

Other names connected prominently with entomological research in Chile have been those of Prof. F. Lataste, Dr. F. Puga Borne, Prof. M. J. Rivera, Dr. Vicente Izquierdo, Hno. Claude Joseph, F. Germain, Prof. Abraham Montealegre, and, very notably, Prof. Carlos E. Porter.

Professor Lataste published many papers, relating largely to taxonomy; Doctor Puga Borne wrote extensively on the poisonous spiders of the genus *Latrodectus*; Hno. Claude Joseph has written extensively on the honey-bearing and predacious Hymenoptera of Chile and on the morphology and biology of *Peripatus*. His work in 1929 was honored by the Alcide d'Orbigny Prize of the Entomological Society of France.

Professor Montealegre was one of the few workers who, without failing to recognize the importance of taxonomy, occupied himself during the last years of his life with the study of the behavior of insects, and published many interesting articles in the daily press of Valdivia and in the *Revista Chilena de Historia Natural*. He was a teacher for more than 30 years; was a member of the Entomological Society of France and of the Academy of Sciences of Chile and the Society of Natural History of Chile.

Filiberto Germain (1827-1913) was born in Lyons, and from 1853 he was the Director of the Museum at Santiago. He was an ornithologist and an entomologist, and worked especially with the Coleoptera. He did a revised catalogue of the Coleoptera of Chile, and published on the Coleoptera of Chile in collaboration with Fairmaire, the noted French entomologist.

Two other Chileans who have done work with insects have been Dr. Federico Teobaldo Delfin and Dr. Clodomiro Perez Canto. Doctor Delfin worked most of his life in the museum at Valparaiso. He was a broad naturalist and his entomological interests were concerned mainly with Coleoptera and Hymenoptera. Doctor Canto, while primarily a bacteriologist, published in 1896 an important article on the embryology of *Margarodes vitium*.

Among the papers published by the men just mentioned, very few have any reference to economic entomology, but in 1897 Prof. Gaston Lavergne, Inspector in charge of the Phytopathological Service in France, came to Chile and founded a phytopathological station. He remained in Chile until 1906, when he returned to France. He published 17 papers largely relating to the vine, but included among them were one on the woolly apple aphid published in 1900, another dealing

with scale insects infesting olives and Citrus fruits, an account of Phylloxera work, a paper on mites as parasites of the grape (concerning *Phytoptus vitis* and *Tetranychus telarius*).

The only strictly economic entomologist of Chile seems to have been Manuel J. Rivera (1875-1910). He became Professor in the Pedagogical Institute at Santiago in 1897, and served as Professor of Natural Sciences at a normal school and then as Professor of Entomology at the Agricultural College of Santiago. In 1906 Professor Rivera visited Europe and the United States, informing himself as to books, machinery, equipment and methods, arranging for an exchange of useful insects between Chile and other countries. I had the pleasure of meeting Professor Rivera in Paul Marchal's laboratory in Paris in 1907 and of greeting him when he visited the United States later in the year. He published a number of papers concerning Chilean insects and several reports under the Department of Agriculture.

A very striking figure in Chilean natural history is Prof. Dr. Carlos E. Porter, a man who has been publishing on scientific topics since 1894 and who was the founder and has been the Director of the Revista Chilena de Historia Natural since 1897. He has a very large bibliography and has written concerning very many insects. Some of his writings have been of an economic character, but they have been very varied. Many honors have come to him, and he is well known all through the scientific world. Americans who have visited him at Santiago speak in the highest terms of his courtesy, of his very great industry, of the breadth of his knowledge. He has an enormous correspondence. He is the founder of the Carlos Porter Prize of the Entomological Society of France. He is apparently a very remarkable man. He has been a warm supporter of the Annals of Applied Zoology, and many of his articles have been published in its pages. He has been untiring in his efforts to enlist the help of foreign naturalists in the working up of the extraordinarily wonderful flora and fauna of Chile and to bring the naturalists of the world into communication with Chilean naturalists and to make the careers of the latter known to fellow workers in other countries. Very many of the facts in this section have been gained through correspondence with Professor Porter, and I gratefully acknowledge his assistance.

Professor Porter was Director of the Museum of Valparaiso, 1897-1911; Chief of the Section of Invertebrates of the National Museum, 1912-1923; Director of the Museum and Laboratory of Applied Zoology from 1914 to date. He has also been a professor in the Naval School and in the Military School and was Professor of Zoology,

Entomology, and Microscopy in the Agronomical Institute, 1911-1923, and also Professor of Animal Parasitology in the National School of Veterinary Medicine, 1919-1923.

As an indication of the esteem in which Doctor Porter and his work are held in the United States, the following preambles and resolution were adopted at the meeting of the Biological Society of Washington, October 20, 1928:

WHEREAS, Dr. Carlos E. Porter founded, 32 years ago, the valuable scientific periodical known as the *Revista Chilena* and has continued it through all the years since, practically single-handed and unaided, with very great expenditure of valuable time and very considerable personal financial loss;

AND WHEREAS, He has, through this journal, made possible the prompt publication of the results of the work of recognized South American scientific men and of those endeavoring to achieve recognition by the publication of the results of their studies in the field of science;

AND WHEREAS, He has built up an extremely valuable and noteworthy zoological library, particularly in the fields of entomology, carcinology, and economic zoology, the best of its kind in his own country, and in doing so has rendered inestimable service to science, not only in Chile but also in other countries in South America;

AND WHEREAS, He has fostered science and encouraged other workers to the utmost of his ability, not only personally but through his teachings and lectures;

Therefore Be It Resolved, That the Biological Society of Washington extends to Carlos E. Porter its hearty commendation and recognition for the great service he has rendered his native land and science in general in the furtherance and perpetuation of scientific research and endeavor.

Late writers (that is, within the last 15 years) in Chile have been S. Camacho, C. S. Figueroa, A. A. da Matta, C. Lizer, and C. Bruch. For example, in 1920 Señors Figueroa and Camacho published on the pests of potatoes and on the black scale respectively; and in 1922 an inspection of the province of Tachna, the most northern province in Chile, was made, and the insect pests received especial treatment. The report was signed by C. Camacho.

PERU

In 1909, Dr. C. H. T. Townsend, a well known entomologist specializing in Diptera, who had worked with the Federal Bureau of Entomology of the United States and had held subsequent posts in New Mexico, Jamaica, and the Philippines, was appointed Entomologist and Director of Entomological Stations of Peru. He held this position for four years; returned to the United States and worked in the Gipsy Moth Parasite Laboratory of the Federal Bureau for four years more; then went to Sao Paulo, Brazil, where he was

Chief Entomologist for three years; then returned to Peru where he became Expert on Cotton Plagues of the Chamber of Commerce and Agriculture at Iquitos and in 1926 Chief Entomologist of the Agricultural Experiment Station at Lima. In 1912 he published a carefully prepared statement entitled (translated) "Entomological Work in Peru." In this paper he attempted to estimate the damage done by insects to the principal crops of Peru, indicating the losses in pounds sterling, as follows: sugar cane, 929,301; cotton, 867,607; coco, 19,466; rice, 22,989; the vine, 79,814; coffee, 19,380; tobacco, 15,530; cacao, 3,630; other crops such as corn, beans, cereals, alfalfa and other forage plants, Citrus and other fruits, olives, yucca, potatoes, sweet potatoes, vegetables of all classes, etc., 625,000; making a total of 2,682,717 pounds [or, in American money, \$12,039,028]. He further indicated that these figures do not include the enormous losses suffered by Peru from the following causes: locust swarms which occur nearly every year in certain parts of the Republic; diseases of cattle, some of which appear to be transmitted by ticks or other biting insects; the practically complete elimination of Citrus cultivation in the coast region of central Peru due to pests which killed off the trees 40 years earlier; the damage to rubber forests and rubber plantations by insects; the immense losses in human lives caused by insects that transmit such diseases as verruga, uta, malaria, bubonic plague, typhus, tuberculosis, cholera, anthrax, and others.

He argued for a governmental service in economic entomology and predicted that a saving of at least half the damage could be effected in a short time. In this paper he went on to generalize further from the situation in Peru as to the whole of South America, pointing out that that continent is the richest region on earth in the variety of insect life.

In the course of his residence in Peru Doctor Townsend published many important papers treating of a great variety of crops and their insect pests. He also did important work in medical entomology and was the first to determine the insect carrier of verruga.

He was given a year's leave of absence by the Peruvian Government in 1927-28, and spent most of his time in Europe gathering data for the completion of a monograph of Muscoid flies. During his absence his post in Peru was held by George N. Wolcott who went there from Haiti where he had been for some time following his holding of an entomological position in Porto Rico. Mr. Wolcott published a good bulletin on plant-lice that attack the sugar cane in Peru, in which he considered the relation of these insects to the mosaic disease of the leaves of the plant.

Mr. Wolcott also published, in the Bulletin of Entomological Research of London (Vol. 20, Part 2, August, 1929), an excellent article entitled "The Status of Economic Entomology in Peru." In this paper he describes in a general way the topography and meteorological conditions of the different parts of the country and the general distribution of the important crops. He shows that Doctor Townsend's original journey to Peru in 1909 was made possible by a strong organization of the larger land holders in Piura for the purpose of making recommendations concerning the common white scale (*Hemichionaspis minor*, Maskell) which was considered to be the most serious pest affecting cotton. Mr. Wolcott also mentions other cotton enemies, and states that for many years the use of arsenicals for killing the leaf-worms has been in practice in Peru but only by means of hand-operated spray pumps even on the largest plantations. He shows further that the cotton growers' association of the Cañete Valley brought Dr. W. E. Hinds, the Entomologist of the Louisiana Experiment Station, to Peru in 1925. Doctor Hinds was there for a few months only, yet, according to Mr. Wolcott, his influence was very great. He suggested dusting the poison on the cotton plants and was largely instrumental in having the airplane application of calcium arsenate widely adopted. It is stated that the Huff-Daland Company went down there in 1926 and during the first season dusted approximately 40,000 acres, doubling this area the next season with no larger personnel and only one additional airplane. Mr. Wolcott considers that airplane dusting is already a standardized commercial practice in Peru, "giving practically perfect results in the control of the leaf-caterpillars." He states that whereas in many cases four or five applications of poison by hand had been needed, one or two by airplane were found ample and the costs have been halved.

Mr. Wolcott's paper goes further, and contains many interesting statements. So it appears that Peru is on the way to an appreciation of the value of economic entomology and quite in the mood to follow up the work of Townsend, Hinds, and Wolcott.

In 1926 O. B. G. Tafur published at Lima an article on cultivation of cotton in the department of Lambayeque, giving some account of a weevil congeneric with the Mexican cotton boll weevil. The species is *Anthonomus vestitus*. In the same year Doctor Townsend published a report on the cotton region of Iquitos, dealing with several species of insects affecting cotton. In 1927 Doctor Townsend published on the so-called white scale (*Pinnaspis minor*), a pest of cotton in some parts of Peru where there is an extreme drought in the hot season.

The results of Dr. W. E. Hinds' stay in Peru will be found in his report on the important cotton insects of Peru, published in the *Journal of Economic Entomology* for August, 1928.

There are three other titles that should be mentioned, namely, a report by Doctor Townsend on the insects attacking cotton and sugar cane in Peru, published in 1928 in the *Bulletin of the Agricultural Experiment Station of the National Agricultural Society of Peru*; another article on the principal cotton insects in Piura, by J. B. Poppe, published in 1929; and Mr. G. N. Wolcott's paper on insects affecting the sugar industry of Peru, published in 1928.

Commercial organizations in Peru seem keenly alive to questions of insect damage and the necessity for expert investigations and advice. The latest evidence of this fact that has come to my attention is the very recent appointment of E. Graywood Smyth, a competent North American entomologist formerly connected with the United States Bureau of Entomology, to be entomologist on the great sugar estates of W. R. Grace & Co. in Peru.

Mr. F. P. Keen, of the Section of Forest Insects of the United States Bureau of Entomology has recently made a hurried trip through South America. Concerning Peru, he writes me the following:

At the present time Peru is one of the most progressive countries in South America in respect to investigative work in economic entomology. This work is being led and directed by the *Sociedad Nacional Agraria* at Lima.

The Society was organized in 1911 to assist the farmers with their agricultural problems. It is a private institution financed largely by the farmers but endowed to some extent by the Government. As a result the farmers demand more service than the Society is able to give with its limited personnel.

The entomological work was started in 1926 under the *Estacion Experimental Agricola* which is a branch of the Society. At the present time Sr. Gerardo Klinge is *Superintendente de la Estacion*, Dr. Johannes Wille, *Entomologo de la Estacion* and Dr. James Pope, *Entomologist for Cotton Insects*. Dr. E. V. Abbott is *Pathologist*. Thus the Station now has three scientists on its staff besides the director, one German and two Americans.

Sugar cane used to be the principal crop but now cotton has replaced it in value, and as a consequence the emphasis is now being placed on the cotton insects.

THE GUIANAS

Dutch Guiana.—North European travelers early made large collections in this colony. Madame Sibilla Merrian made her great collections of *Lepidoptera* there, and her beautiful drawings which are still the admiration of lepidopterists. The principal contribution of the Dutch people to economic entomology from Guiana is the large monograph of the mosquitoes of Surinam made by Dr. C. Bonne and his wife, Mrs. C. Bonne-Wepster. Conceived and largely exe-

cuted during a long residence there, it was published in 1925 in Amsterdam. The Bonnes were in frequent correspondence with the Bureau at Washington, and on their way home to Holland in 1919 they spent several months here studying the great mosquito collections in the National Museum with Dr. H. G. Dyar.

British Guiana.—As we have pointed out under the head of the West Indies, British Guiana has practically the same entomological problems as Trinidad, the fauna and flora of Trinidad being essentially that of northern South America, as it is rather an island promontory than a removed island. A number of British collectors visited British Guiana in times past, and the English collections, especially those of the British Museum of Natural History, contain a great deal of material from that country. Many interesting observations on points relating to the biology of tropical insects were made there.

Official economic entomology was not taken up in this country until 1912, when Mr. G. E. Bodkin, a young Englishman, was appointed Government Economic Biologist. He passed through Washington in December of that year, on his way to his post, and I met him afterwards at the conference of the Imperial Bureau of Entomology in London in 1920. Mr. Bodkin was a well trained man and did admirable work. He remained in British Guiana, publishing mainly on entomological subjects, until 1922, when he went to Palestine. During the term of his British Guiana residence he published many important annual reports, and, from 1913 to 1923, 27 of his articles were reviewed in the Review of Applied Entomology. He was succeeded in office by Mr. L. D. Cleare who had previously been associated with him. A sound entomological article by Mr. Cleare is reviewed in the first volume of the Review of Applied Entomology (1913), but apparently he did not begin to publish extensively until after he assumed the position vacated by Mr. Bodkin.

Probably the main entomological problems of British Guiana center around the cultivation of sugar cane, and the majority of the papers published by Bodkin and by Cleare relate to some phase of insect damage to this crop. The large sugar-planting companies of that colony, notably Messrs. Curtis, Campbell & Co. and Messrs. Booker Brothers, McConnell & Co., Ltd., carried on investigations for a time independent of the colonial government. Mr. John J. Quelch was for some years Curator in the Museum at Georgetown, and afterwards worked on a group of these sugar estates on the control of the *Diatraea* borer and other pests. I am informed by Professor Ballou that Mr. H. W. B. Moore was discovered when a

youngster by Mr. Quelch and was trained by him, and that when Quelch some time in 1911 left British Guiana Mr. Moore took over the work. Mr. Moore corresponded with specialists in Washington and elsewhere on the subject of the identification of his material; and the work started by Mr. Quelch and continued by him consisted largely of the collection of the moths and caterpillars of *Diatraea* and *Castnia* and also of their eggs. Since many of the eggs were parasitized, arrangements were made by Mr. Moore to collect them and keep them in such a way that the parasites could emerge while possibly surviving host larvae could not. Mr. Moore published from 1914 to 1917, but I have seen none of his reports later than that. It is interesting to note that the sugar planters of Trinidad have made several attempts to import parasites of sugar cane insects from Guiana, and that Mr. Harold E. Box, working for the Porto Rico Sugar Planters' Association, made his first attempts to secure parasites of the sugar cane froghopper from the Guianas.

UNITED STATES OF COLOMBIA

The United States of Colombia is a country that has been the prolific hunting ground of many collectors in natural history, but seems to have developed few native entomologists. The country has suffered from the cacao-beetle, and the Federal Bureau of Entomology in Washington has received letters from many individuals in reference to this and other insect damage.

In the *Revista del Ministerio de Industrias*, Bogota, for May, 1916, is a report by A. Girardi on plant aphids, evidently written by a scientific man, and mentioning natural enemies and proper sprays. In the June number is an article on the potato tuber moth, and another one on the fungicides and insecticides most commonly used to combat the diseases of plants.

In 1919, in the *Agricultural Review*, Bogota, was published an article by J. Figueroa on the cultivation of clover, in which the insect enemies are considered. In the same journal for that year is an article on the locust, by A. Lopez.

In 1927 the *Industrial Review* at Bogota published an article by H. Apolinar Maria on insects in the pastures of the savannah of Bogota.

In the year 1927 the Departamento de Agricultura y Zootecnia was founded, and among the Technical Divisions created in the Department was that of Entomology. Señor Luis María Murillo was placed in charge of this division. He submitted a report on June 1, 1929, outlining his organization. A small laboratory had been estab-

lished in "La Picota" and work had been begun on the biology of fruit-flies and of grain weevils as well as parasites of coffee trees and a general study of parasites of injurious insects. An especial campaign had been begun against the woolly aphids of the apple.

In 1929 an experiment station was established at Medellín in the State of Antioquia. A well trained economic entomologist from the United States, Mr. Charles H. Ballou, was appointed and is at present located in Medellín. Mr. Ballou is not fairly started. He writes me that he has been unable to find that any important work has been done in that country, although he has seen published documents relating to injurious locusts and to the *Coccobacillus acridiorum* of d'Herelle and recounting the work against locusts by Dr. Luis Zea Uribe in 1913 in Tocaima and that of Prof. Federico Lleras A. on work in Guduas, both, as I understand it, with the d'Herelle fungus and with good results. Mr. Ballou also tells me of a popular book on the domestic silkworm by Aureliano Vélez C., published in 1923, and still another on silk by Ernesto Murillo published the same year.

Still another paper that Professor Ballou has seen is by Rafael A. Torro, a 34-page pamphlet published in 1927 and entitled (translated) "The Diseases and Pests of Plants: Their Causes and Control."

VENEZUELA

In Venezuela there have been many both foreign and native collectors, but economic entomology has received comparatively little attention. In 1925 the Ministry of Fomento of that country published a bulletin of 60 pages by Roberto Alamo Ybarra, Agricultural Engineer, entitled (translated) "Two Insects Injurious to the Cultivation of Cotton." One of these insects is a leaf-worm and the other is a boll-worm. When the bulletin was published the author was of the opinion that the leaf-worm was *Alabama argillacea*, the tropical species which flies north every summer and gives birth to the so-called leaf-worm, or cotton caterpillar, of the southern United States; but, according to Dr. C. H. T. Townsend, it is probably a species of *Anomis*.

The insect considered as a boll-worm was, after the publication of the bulletin, sent to the United States for identification, and, on study, Dr. William Schaus of the United States National Museum decided that it is *Sacadodes pyralis* Dyar. As a result of this identification and of further studies, a revision of the bulletin became necessary, since, on the supposition that this boll-worm of Venezuela was identical with the old cotton boll-worm of the United States, the author had assumed a secondary host plant in maize and had based

some of his remedial recommendations upon this supposition. I believe that the bulletin has not been reprinted, but is issued with certain portions relating to this supposed secondary host plant crossed out.

Dr. G. Torres, the present Minister of Fomento of Venezuela, has informed me, through the Director General of the Pan American Union, that his Department has no special service in entomology, but that whenever some case of sufficient importance presents itself the Agronomist of the Department, Dr. Roberto A. Ybarra, is commissioned for its investigation.

THE CENTRAL AMERICAN REPUBLICS

I regret that there is not more to be said about Central America. In Panama Mr. James Zetek has long been stationed under the United States Department of Agriculture. His post has become a general entomological station for the humid Tropics. Many entomologists visit it for varying periods of time, and Mr. Zetek spends much energy in helping them. The specific problems attacked cover an attempt to gain a knowledge of tropical fruit-flies in America, their relationships, host preferences, and life cycles. The station in fact is devoted to the immediate problems of the Canal Zone and to research on pests native to the tropical rain forest areas. It is in fact the only American outpost laboratory in the humid Tropics where research can be done on some of the most dangerous pests.

The insect fauna of the other Central American countries has long been studied, and collectors from different parts of the world have frequently visited the Central American republics. Many years ago the Englishman, H. W. Bates, published a fascinating book called "*A Naturalist in Nicaragua*," which aroused keen interest in the natural history of that part of the world. Much later, collectors were sent by Messrs. Godman and Salvin, of England, to get added material to be used in the production of the great work that afterwards appeared in parts, entitled "*Biologia Centrali-Americana*." Very many specialists worked over the material brought together for this great enterprise, the illustrations prepared for it were wonderfully well done, and the entire work was monumental.

Economic entomology, however, has received little or no attention. Efforts to improve the agriculture of some of the countries have been very intelligently pushed, as for example in San Salvador, where a capable official from the United States, Mr. F. W. Taylor, for some time held the post of Director General of Agriculture. To Guatemala experts have gone on several occasions to study agricultural problems.

The United Fruit Company has done much to encourage agricultural production, and from time to time has commissioned entomologists for short periods to visit especially Honduras for investigations and advice.

In the effort to secure official information for me, the Director General of the Pan American Union, Dr. L. S. Rowe, very kindly sent letters to the Ministers of Agriculture of the different countries asking concerning any official work that had been done or that had been undertaken regarding injurious insects. The Minister of Agriculture and Labor of Nicaragua, Señor J. A. Cabrera, courteously replied that there was nothing of note that could be reported. The absence of information from the other countries means plainly that nothing official has been done.

There is at the present time, and has been for some years, an enlightened Ministry of Agriculture in Guatemala, and there has been published at Guatemala City a bulletin entitled "*Boletín de Agricultura y Caminos*." In the number for June and July, 1929, there are outlined the plans for a new Chemicoagricultural Institute under the Ministry of Agriculture, and in the number for May, 1929, was published an interesting article on the insects injurious to coffee by Manuel A. Bardales, Agricultural Engineer, apparently connected with the National Central School of Agriculture. In this he treats of the species of the genus *Lecanium* that affect the coffee plant.

Collections and studies in Guatemala have been made by the writer's colleagues, E. A. Schwarz, Herbert Barber, William Schaus, James Barnes, and O. F. Cook; and the last named, Professor Cook, being greatly interested in cotton, at one time found a predatory ant in Guatemala known locally as the "kelep" which he thought protected cotton in that country from the so-called Mexican cotton boll weevil. He brought a colony of this ant to the States, and it was studied and encouraged for some time at Victoria, Texas, but the species did not accommodate itself to Texas conditions.

A rather lengthy manuscript report has been received from the Ministerio de Agricultura of Guatemala, through the courtesy of the Pan American Union, which indicates that constant attention is being paid to the study of entomology in Guatemala although no trained entomologist seems to be employed. Two agronomical engineers, namely Señor Jorge García Salas and Señor José Cosyins, have made trips through the different agricultural regions of the Republic, investigating the occurrence of injurious insects and of plant diseases. It was reported that the European corn borer had made its appearance in the corn fields near Ciudad Veija. When this report reached

Washington, Mr. C. Heinrich, an expert in the Federal Bureau of Entomology, was sent to Guatemala on an investigating trip in 1929. He found that the European corn borer does not exist in that country but that the reports had been caused by a certain amount of damage done by one of the native corn borers, the larva of *Diatraea lineata*.

A report from the Ministry of Agriculture shows that the present administration is thoroughly alive to questions of insect damage and that competent investigations will probably be made. Mr. Heinrich reported that he was received with the greatest courtesy by Señor Manuel Herrera, the Minister of Agriculture, and was given every facility for carrying out his investigation. Mr. Heinrich was also greatly assisted by the United Fruit Company, and informs me that a good entomologist from the United States, Mr. Marston Bates, has been appointed Entomologist to the United Fruit Co. and, although his headquarters are at Tela, Honduras, spends considerable time in scouting and field work in Guatemala.

BRITISH WEST INDIES

A great many West Indian insects were sent to the principal museums of the world, and especially the British Museum of Natural History, from very early dates; and insect damage to crops began at an early time. In the year 1801 a special commission composed of members of the General Assembly of the Bahamas was appointed to investigate the damage done to the cotton crop by the red bug (*Dysdercus* sp.) and the chenille (*Alabama argillacea*). Insect damage to cotton was very marked even before the beginning of the nineteenth century. It is probable that early in the eighteenth century cotton cultivators were accustomed to the injuries of a worm that appeared in great numbers. In Guiana the cotton caterpillar was known to the earliest cultivators of cotton in that country (1705 to 1752). In the Bahamas it was also destructive. In 1788, 250 tons of cotton were devoured by this worm. In 1794, the crop suffered severely in the same way. In 1801 and 1802 there was an emigration of French cotton planters from Martinique to southwest Georgia on account of the ravages of the cotton caterpillar.

After the special commission of 1801, however, no governmental or other work seems to have been done or authorized for approximately 90 years.

About 1890 the Department of Agriculture at Washington began to receive requests for information about injurious insects from several of the West Indian islands. Mr. H. De Courcy Hamilton, of Montserrat, began to study the insects injurious to Citrus trees which

were being grown extensively on that island. A little later, Mr. Claude W. McCallan, of Bermuda, appealed to Washington for suggestions in regard to the Mediterranean fruit-fly which was destroying the peach crop of that island. A correspondence began with Mr. C. A. Barber, Superintendent of Agriculture of the Leeward Islands, on the subject of the sugar cane shot-borer, and with Mr. H. Caracciolo and Mr. F. W. Ulrich of Trinidad.

In 1891, T. D. A. Cockerell, of England, was appointed Curator of the Institute of Jamaica at Kingston under the especial condition that he should conduct investigations in economic entomology and answer all correspondence of this kind which might come from the planters. Mr. Cockerell found scale insects extremely abundant in Jamaica and began their study. He started a series of stylographic notes, mainly about injurious insects, and distributed them among the planters. He was succeeded by C. H. Tyler Townsend, who held office for about a year.

In 1898 the Imperial Department of Agriculture for the West Indies was established with headquarters at Barbados, and Sir Daniel Morris, coming from Kew Gardens in London, was appointed Commissioner. In 1899, Mr. H. Maxwell Lefroy was sent over from London to take the position of Entomologist. In 1903 he was transferred to India. Mr. H. A. Ballou, of Massachusetts, was appointed as his successor, and still retains the position.

In the late nineties, the Trinidad Field Naturalists Club was active in entomological work, and succeeded eventually in having an entomologist appointed in the person of Mr. F. W. Ulrich, who had as assistant Mr. P. L. Guppy. The first publication was on the life history and control of the cacao-beetle, by Mr. Guppy, a well illustrated pamphlet with an excellent colored plate. This was followed by regular annual reports and by other papers, including one on some insects affecting the coconut palm by Messrs. Ulrich and Guppy, one on the cotton stainer by Mr. Guppy and Thomas Thornton, one on froghoppers by J. C. Kershaw, and an admirably illustrated account of the sugar cane froghopper with biological notes on other species by Mr. Ulrich, as well as other papers.

It is interesting to note that, in the opinion of many residents of Trinidad, the damage done by insects on the island and the great increase of this damage, especially by the sugar cane froghopper, must be attributed to the introduction of the Indian mongoos into Trinidad in the closing part of the last century. It was brought in to destroy rats. It increased rather rapidly, and was found to destroy young pigs, kids, lambs, kittens, puppies, poultry, birds of all kinds

nesting near or on the ground, ground lizards, snakes, frogs, turtle eggs, and land crabs. Many of the animals it destroyed feed normally on insects. So in 1902 the Government began to give bounties for the destruction of this animal.

Whether the increase of the sugar cane froghoppers was due to the introduction of the mongoos or not, a thorough study of the insects was necessitated by their increase. In 1915 Mr. C. B. Williams, an English entomologist who had studied in the United States, was engaged by the Board of Agriculture. He attempted to find an efficient parasite elsewhere. Foreign travel was rendered very difficult by the war; so he confined his investigations to near-by countries and islands, going as far as Panama. He returned to Trinidad in July, 1917, and continued his investigations. At the close of 1920 he published a full report which was well illustrated. After that he went to Egypt to accept an entomological position under the Government of that country.

In 1925 a Froghopper Investigation Committee for Trinidad and Tobago was established, and this committee has continued in existence until the present time. It has published its minutes and proceedings in 14 pamphlets, the last one being dated 1929 and including the proceedings of the meeting of December 19, 1928. At this last meeting Dr. J. G. Myers, an expert connected with the Imperial Bureau of Entomology in London, stated that he had been sent to the West Indies and the adjacent mainland with a view to the introduction of natural control methods so far as possible in cases of severe insect damage.

To revert once more to Jamaica, a number of years after C. H. T. Townsend resigned, A. H. Ritchie, a Scotsman who had been studying as a Carnegie Scholar in the United States, was appointed Entomologist for a period and made some very good studies both in agricultural and medical entomology. After the World War he was appointed Entomologist to the Tanganyika Territory, and was succeeded in Jamaica by Mr. C. C. Gowdey who had been Entomologist to Uganda. This must have been in 1920. Mr. Gowdey died in 1928.

Mr. Gowdey's term in Jamaica was filled with industry. Perhaps the most important thing that he did was to prepare his catalogue of Jamaican insects, which was published by the Department of Agriculture as Entomological Bulletin No. 4, Parts 1 and 2. It was very carefully done and well printed, covering 114 pages, with a competent index. All the species known to have been found in Jamaica down to July 31, 1925, are included. The catalogue includes as an appendix a paper on "New Diptera from Jamaica" by C. H. Curran.

Late in 1929 the post was filled by the appointment of Mr. W. H. Edwards, by transfer from Mauritius where he had been Assistant Entomologist.

To return again to Bermuda and the Bahamas: it should be stated that these islands have been outside the control of the Imperial Bureau of Agriculture and that little official work has been done in them. Toward the close of the last century the Agricultural Society of Bermuda became intensely interested in the increase of the Mediterranean fruit-fly. Mr. Claude W. McCallan, as previously mentioned, appealed to Washington for assistance, and the United States Government became especially interested in this insect at that time. I prepared an illustrated article entitled "A Peach Pest in Bermuda," which was published in Volume 3 of *Insect Life*, pages 5 to 8 (August, 1890). This article called attention to the danger of the importation of this pest into the southern States, indicating that such accidental importation is always possible. A committee of the Agricultural Society of Bermuda under the leadership of Mr. Ambrose Gosling, after exhausting apparently all other resources, made an attempt to wipe out the pest by destroying for a single season all fruits of the kinds known to be affected. This expensive and attemptedly radical effort failed through the fact that some inconspicuous fruit (I think, the so-called ground cherry) was overlooked; and it is thought that the present Florida infestation came from Bermuda.

In 1923 Mr. L. Ogilvie was appointed to the position of Plant Pathologist of Bermuda, and his duties included investigations of injurious insects. In 1929 he was succeeded by Mr. H. S. Cunningham. Mr. Ogilvie left Bermuda in 1928 and is at present Advisory Mycologist to the Agricultural and Horticultural Research Station, Bristol University, Long Ashton, Bristol, England. Just before he left Bermuda, he published under the Department of Agriculture a 52-page pamphlet entitled "The Insects of Bermuda." It is a list of species with comments.

The story of the work undertaken under the auspices of the Imperial Bureau of Agriculture for the West Indies during the period from October 1, 1898, to March 31, 1911, is carefully considered in a lengthy article entitled "Entomology in the West Indies" published on pages 282 to 317 of the *West Indian Bulletin*, Volume 11, No. 4, 1911. It was written by Mr. H. A. Ballou, who, as we have just stated, assumed the office of Entomologist in 1903. In referring to early work before the establishment of the Bureau, Mr. Ballou mentions the work of W. Fawcett in Jamaica, that of C. A.

Barber in Antigua, of J. H. Hart in Trinidad, and J. R. Bovell in Barbados. The contributions made by Mr. Ballou himself during that period were very important and include strong articles on insects affecting cotton, sugar cane, and cacao. He also published numerous shorter notes, as well as an important monograph of the insects known as "cotton stainers"—true bugs of the genus *Dysdercus*. He continued work of this kind and carried it on very efficiently under the same governmental position until 1922 when the Imperial College of Tropical Agriculture was established at Trinidad. This was the outcome of the efforts of Sir Francis Watts, Commissioner of the Imperial Department of Agriculture for the West Indies, who had been advocating such an educational institution for many years. He was made the first Principal of the College. The nucleus of the College staff was the staff of the Imperial Department, and for the first year or two this nucleus did the whole work. The College was charged, in fact, with the carrying on of the work of the Imperial Department, and since 1922 the Professor of Entomology (Mr. Ballou) has still functioned as the Entomologist of the Department of Agriculture. On the establishment of the College, he not only became Professor of Entomology but carried on his work as Assistant Commissioner of Agriculture for the West Indies. More recently he has been appointed Commissioner of Agriculture, and still carries on the duties of Professor of Entomology and all the entomological work for the Lesser Antilles. At the end of 1927 Mr. F. W. Urich retired from the Trinidad Department of Agriculture and was appointed Assistant Professor of Entomology at the College.

During the past few years the majority of the students have been postgraduates, mostly from British universities and colleges of recognized standing, most of them going directly from college to appointments on existing agricultural staffs in the colonies. The institution is one of high standing, and fills a very useful function in the British Empire, since so many of her dominions and colonies are situated in the Tropics, and of course a thorough training in the tropical aspects of the different agricultural sciences is necessary to the experts who take positions around the world within tropical limits.

There is one more entomological officer in the British West Indies. Mr. R. W. E. Tucker holds the official position of Government Entomologist of Barbados.

A number of other men should be mentioned in connection with West Indian work, from the Rev. Landsdown Guilding who during his long residence on the island of St. Vincent published a dozen

or more important papers in the Transactions of the Linnean Society and the Magazine of Natural History on West Indian insects, including an important paper on the insects which infest the sugar cane and the first account of that extraordinary Coccid, *Margarodes formicarum* (1828), down through the later workers. It should be noted that C. C. Gowdey, before he went to Uganda, went to the West Indies to join Ballou shortly after his own graduation from the Massachusetts Agricultural College, and published a good paper on the Aleyrodidae of Barbados. It should also be stated that Dr. J. C. Hutson worked down there on cotton insects and that W. Nowell and J. S. Dash also worked in Barbados. The work of the Englishmen, Guelch, Moore, Bodkin, and Cleare, in British Guiana might also be mentioned here, but has been taken up under the head of South America, although Trinidad, which is considered in this section as one of the West Indies, has the Guiana fauna and is really little more than an island promontory from the South American coast.

Fortunately, a summary of the entomological work undertaken by the Imperial Department of Agriculture during the period from October 1, 1898, to March 31, 1911, was published by Professor Ballou in the West Indian Bulletin, Volume 11, No. 4, 1911. This is a very careful and detailed report and brings out very many points that cannot be mentioned in this limited account. In addition to the names already mentioned, it should be noted that W. K. Morrison, Dr. R. Hamlyn-Harris, and Charles W. Jemmett were temporarily attached to the staff of the Imperial Department as Honorary Assistant Entomologists at one time or another during the period mentioned. Doctor Hamlyn-Harris was there from October 10, 1902, to January 31, 1903. He has recently been doing admirable work as a sanitary entomologist in Australia. Appended to the article is a list of entomological publications in the West Indian Bulletin, Volumes 1 to 11, and specially published pamphlets. The list includes 45 papers on different aspects of economic entomology.

In the closing days of 1929 an excellent paper comes to my desk entitled "The Giant Moth-borer of the Sugar Cane (*Castnia licus* Dr.)" by H. Martin Skinner, in charge of plant control work of the Ste. Madeleine Sugar Co., Trinidad. It contains a very beautiful colored plate of the insect.

CUBA

The very interesting tropical fauna and flora of Cuba attracted attention at an early date, and many of the great museums of Europe

contained species sent from Cuba by travelers and by residents. But Cuban natural history was not at all well understood as a whole until the days of Felipe Poey (1799-1891) and Juan (Johann) Gundlach (1810-1896).

Poey was born in Habana, studied in Paris as a young man, and spent the rest of his life in Cuba. In one of his biographies it is stated that he was one of the founders of the Entomological Society of France. In the list of 35 founders in the *Annals* of this great Society for 1832, occurs the entry, "Poey, Avocat à la Cour royale." If this were indeed the Cuban Felipe Poey, he must have been a resident of Paris at that time (at the age of 33). Poey was an indefatigable naturalist, collected and wrote extensively, published several papers on Cuban Lepidoptera, and was the author of a great "Natural History of Cuba."

Gundlach was born in Magdeburg, went to Cuba in 1838, and, indifferent to financial gain, spent his life collecting and studying birds, fishes, and insects as well as other animals. He was in active correspondence with scientific societies and museums in Europe and the United States, and much of his collected material passed through the hands of foreign specialists. In the 1880's he began to build up the Museum of the Institute of Habana, and spent several years in thorough collecting expeditions over the island. The years 1884-88 were spent largely in the museum at Habana, working over the collections.

The Cuban Agricultural Experiment Station (Estación Experimental Agronómica) at Santiago de las Vegas, Province of Habana, was founded in 1904, and began operations on April 1. I am indebted to Mr. S. C. Bruner, Chief of the Department of Plant Pathology and Entomology of this Station, for the following full account of applied entomology in Cuba.

The Department of Plant Pathology of the new Station included both plant pathology proper and entomology. The head of this Department was Dr. Mel. T. Cook who served until September, 1906; the assistant of this Department was Mr. H. T. Horne. While both of these gentlemen were primarily plant pathologists, work in both fields was carried out. In June, 1905, Bulletin No. 1 of the Station was published, entitled "Insects and Diseases of Tobacco," by Doctor Cook and Mr. Horne. In the first report of the Estación Agronómica (1906), in the report of work of the Department of Plant Pathology (period April, 1904, to June, 1905), Doctor Cook gives an account of the very considerable amount of work done on the insects and diseases of tobacco, coffee, orange and other fruits, corn, cotton, sugar cane, vegetables, etc., although this was necessarily of a preliminary nature.

In 1905 Bulletin 3, also by Cook and Horne, on "The Coffee Leaf-miner and Other Coffee Pests," appeared.

Mr. W. T. Horne, in September, 1906, succeeded Doctor Cook as Chief of the Department of Plant Pathology. In May, 1907, Bulletin 7, entitled "Insects and Diseases of Corn, Sugar Cane, and Related Plants," by Cook and Horne, was published. Following the promotion of Mr. Horne, Mr. J. S. Houser was appointed assistant in the Department of Plant Pathology to fill the vacancy, having served prior to that time as assistant entomologist in the Ohio Agricultural Experiment Station. The following year, 1907, a position of second assistant was created and Sr. Sebastián Plá was appointed to the position. Bulletin 9, "Insects and Diseases of the Orange," by Cook and Horne, was published in February, 1908, and in May, 1908, Bulletin 12, entitled "Insects and Diseases of Vegetables." In July, 1908, Bulletin 15 by Mr. Horne, on "Bud Rot and Other Diseases of Coconut in Cuba," was published. This includes reference to the insects, as well as diseases.

In Part 2 of the Second Report of the Experiment Station (June 30, 1905, to January 1, 1909), published in 1909, Mr. J. S. Houser published a paper on "The 'Candelilla' or Leaf-miner of Tobacco, *Phthorimaea operculella* Zell." In the same publication there appeared an article on the "Damage to Pines in Cuba Due to *Dio-ryctria* sp. and other Lepidoptera," by Horne and Houser.

Mr. Houser retired from the Station in the early part of 1909 and Mr. Horne also, at which time there was a radical change in the personnel. The next bulletin containing information on economic insects was No. 20, published in July, 1911, entitled "Insects and Diseases of Cassava in Cuba (Insectos y enfermedades de la yuca en Cuba)" prepared by Sr. Patricio P. Cardín (B. S., 1909, Massachusetts Agricultural College, Amherst), who alone carried on the work of entomology and pathology from July 29, 1909, until July, 1914. He was primarily an entomologist. In September, 1914, a Plant Pathologist was appointed and a separate department for this work temporarily created, Sr. Cardín remaining in charge of the Department of Entomology. Mr. H. C. Eagerton was appointed Assistant Entomologist in November, 1914, but remained at the Station for only a month and a half. Dr. J. C. Hutson (Ph. D., Massachusetts Agricultural College) became Assistant Entomologist in July or August, 1915, and served until October, 1916. Mr. Reginald Hart (B. S., Mass.) was appointed to succeed him, reporting for duty October 1, 1917, and served until July 19, 1918. Sr. Oscar Arango was then

appointed to this position on September 10, 1918. In the meantime the Departments of Plant Pathology and Entomology had been reunited with Sr. Cardín as Chief, and S. C. Bruner as Assistant Chief (*Segundo Jefe*). On the death of Sr. Cardín, on September 29, 1919, Mr. Bruner was appointed Chief of this department, and Sr. Arango was promoted to fill the vacancy left by the latter, Sr. Braulio T. Barreto being appointed Assistant Entomologist at the same time. The position of Assistant Entomologist was abolished for economy in 1921 together with a number of similar positions at the Experiment Station, but Sr. Barreto continued at the Station with a temporary appointment until December, 1925. There have been no other changes in the staff of this Department to date, February, 1930.

Following the publication of Bulletin 20 on insects and diseases of Cassava plant in Cuba, Sr. Cardín published in 1912 and 1913, in Circulars 42 and 43, a paper on "The Insects and Diseases of Avocados." In the same Circular No. 43 (1913) appeared a short paper by Mr. J. S. Houser entitled "Informe preliminar sobre las Plagas de la Caña de Azúcar en Cuba (Preliminary Report on the Sugar Cane Pests of Cuba)" translated from the English by Sr. Cardín; he also was author of Circular No. 33 (March, 1909) on Insecticides and Fungicides. In 1915 the third report of the Cuban Experiment Station appeared (period February, 1909, to July 30, 1914) which includes (pp. 98 to 216), in the Report of the Department of Plant Pathology and Entomology by Sr. Patricio Cardín, an annotated list of economic insects and plant diseases of Cuba arranged alphabetically according to the plant attacked. This work contains much valuable information. Sr. Cardín also published a paper on the black fly (*Aleurocanthus woglumi* Ash.) in the official Revista de Agricultura, Comercio y Trabajo (May, 1918) and another on pests of the castor oil plant in Cuba (October, 1918). In the report for 1917-1918 of the Station (published 1919) Sr. Cardín gives a short account of his studies of the black fly of Citrus and other insects.

Mr. Reginald Hart published a number of papers in the Revista de Agricultura, Comercio y Trabajo, including a paper on the pepper weevil (*Cryptorrhynchus cubae*) (September, 1919), Grosella looper (*Melanchroia geometroides*) (November, 1919) and in the same year an annotated list of Cuban agricultural pests in tabular form, in two parts including a number of new items.

Sr. Barreto, during the time he served in the Department, published in a series of short papers on economic insects, particularly on pests of sugar cane, lima beans, fruit trees, bees, etc., mostly in the Revista de Agricultura referred to, and Bulletin 42 of this Station.

entitled "La Bibijagua y modos de Combatirla" (The Leaf-cutting Ant [*Atta insularis*, Guerin] and its Control).

Sr. Oscar Arango published several short articles in the official Revista de Agricultura, Comercio y Trabajo (Habana) on economic insects, and in 1927, Circular 63 on the preparation and application of insecticides; also a leaflet, prepared jointly with S. C. Bruner, on the control of the black fly (*Aleurocanthus woglumi* Ash.) published in 1928.

The contributions of S. C. Bruner, aside from work in plant pathology, mycology, and systematic entomology (Hemiptera and Homoptera) consist of Bulletin No. 38 of the Experiment Station on the diseases of the orange and other Citrus plants, prepared jointly with Prof. J. R. Johnston (August, 1918), in which are considered the rust mite and red spiders attacking these plants in Cuba; a paper on the transmission of sugar cane mosaic by insects (Revista de Agricultura, Comercio y Trabajo, Vol. 5, No. 1, March, 1922), observations on the Citrus black fly, on certain sugar cane pests, on the seed chalcid of amonaceous fruits (*Bephrata cubensis* Ashm.), notes on royal palm bug (*Xylastodoris luteolus* Barber), on the green Citrus aphid in Cuba (*Aphis spiraccola*, Patch), on the use of paradichlorobenzene for destroying the leaf-cutting ant (*Atta insularis*, Guerin), on the use of calcium cyanide for destroying the same insect (with S. W. Bromley), on scale insects attacking coffee in eastern Cuba, on the appearance of the cottony cushion scale (*Icerya purchasi*, Mask.) in Cuba and the subsequent importation of *Rodolia cardinalis*, etc., published largely in the Revista de Agricultura, Comercio y Trabajo. He is also author of the general report of the work of the Department of Plant Pathology and Entomology for the years 1925 to 1928, etc., included in the "Memoria General de la Secretariade Agricultura, Comercio y Trabajo" (1928), Habana, and of Circular No. 68 (June, 1929) of the Experiment Station, on the pests of the coffee plant in Cuba.

In November, 1928, an agreement was entered into between the Departments de Agricultura of Cuba and the United States for the importation into Cuba, from the Orient, of parasites and other natural enemies of the Citrus black fly (*Aleurocanthus woglumi* Ash.), the work to be carried on as a cooperative project. Dr. A. C. Baker of the Bureau of Entomology was designated to represent the United States Department of Agriculture, and Mr. Ernesto Sánchez Estrada, acting Chief of the Sección de Sanidad Vegetal, Habana, and S. C. Bruner, Chief of the Department of Plant Pathology and Entomology, of the Agricultural Experiment Station, Santiago de las Vegas, were designated to represent the Cuban Government. This work is now under

way, Mr. C. P. Clausen is at present in the Malay Peninsula collecting and preparing the insects for shipment, while at the Cuban Experiment Station an insectary has been built, and the necessary work is being carried on to care for them as shipments are received. Mr. Paul A. Berry, of the United States Bureau of Entomology, is now engaged in this work at Santiago de las Vegas.

Notes on the Plant Quarantine and Pest Control Service in Cuba.—The first organization of this kind in Cuba was called the "Comisión de Fitopatología" and was created in the year 1913 or 1914. Its president was the Director of Agriculture (the late Don Roberto Luaces). The positions of the officials as well as of the inspectors were all honorary in nature.

On July 3, 1916, the "Comisión de Sanidad Vegetal" was created, being composed of three members: Mr. J. R. Johnston, President, Plant Pathologist of the Experiment Station; Sr. P. Cardín, Entomologist of the Experiment Station, and Dr. M. Sánchez Roig, Professor of Natural History in the provincial agricultural institute or high school (Granja Agrícola).

On September 12, 1917, a separate organization for this work was created under the name of "Oficina de Sanidad Vegetal." Mr. J. R. Johnston was appointed Chief with three inspectors and three foremen with provision for the employment of laborers. The appearance of the Citrus black fly (*Aleurocanthus woglumi* Ash.) a short time previously was really responsible for the creation of the "Oficina" at this time, when an unsuccessful campaign for its control was begun which lasted several years. A month later (October 1, 1917) additional inspectors were provided for.

On July 1, 1925, the name of the Office was changed to that of the present time: "Sección de Sanidad Vegetal." Its personnel consists of (nominally): a chief, 3 chief inspectors, 1 second-class inspector, 4 third-class inspectors, and 6 fifth-class inspectors; as well as 3 foremen and 20 laborers. There are, in addition, 20 temporary inspectors (fifth class) and the necessary clerks, typists, etc. The service is also provided with two omnibuses, or trucks, equipped for extension work, as well as several automobiles and trucks for other work.

The publications of this service consist of annual reports, bulletins, and circulars, the two latter consisting largely of information in popular style on means of controlling the mosaic disease of sugar cane, the Citrus black fly, the coconut bud-rot disease, the Panama banana disease, scale insects and other pests; and the regulations in force concerning plant quarantine and pest control.

The personnel of this service has of course undergone many changes since it was created. Mr. R. Hart and Mr. C. H. Ballou served at one time as inspectors, the latter also as "Entomologist." Dr. M. Sánchez Roig (D. en C. and D. en M.) succeeded Mr. Johnston as Chief of the service, and served until early in 1926. Mr. S. C. Bruner acted as Chief *ad interim* a short time during the fall of 1926, until Dr. Ruíz Mesa (D. en M.) the present Chief was appointed. Mr. E. Sánchez Estrada is now the Acting Chief of the Service, and Major Jesús L. Vega (D. en M. V.) is the "Military Supervisor."

In 1924 the Tropical Plant Research Foundation of the United States National Research Council established an experiment station at Central Baragua, at the request of an association of Cuban cane planters known as the Cuba Sugar Club. The station is known as "Estación Experimental del Club Azucarero de Cuba." Mr. D. L. Van Dine, long-time member of the staff of the United States Bureau of Entomology and at one time engaged in entomological work in Hawaii and later in Porto Rico, went to Cuba in November, 1924, with C. F. Stahl, also an old employee of the United States Bureau, as his assistant. Later Mr. Van Dine became local director of all the work, including pathology, agriculture, and chemistry, and the organization was changed from a project basis to the standard experiment station plan. Mr. Stahl became chief entomologist, and Mr. H. K. Plank, also formerly of the Bureau, was engaged later. Mr. Stahl resigned in 1929, and his place was taken by U. C. Loftin, also formerly of the United States Bureau. Mr. L. C. Scaramuzza has been an entomological assistant and has been working on the biology of moth-borer parasites. These men have done excellent work and have published seven Bulletins and eight Scientific Contributions. An especially good article by Mr. Plank entitled "Natural Enemies of the Sugar Cane Moth-Borer in Cuba" was published in the Annals of the Entomological Society of America, Vol. 22, No. 4, December, 1929, pp. 621-640.

PORTO RICO¹

The insect fauna of Porto Rico and other islands of the West Indies has attracted the attention of naturalists since the early days

¹The major part of this section on Porto Rico has been prepared at my request by Dr. R. T. Cotton, who tells me that the statements regarding the early entomological history of Porto Rico have been gathered from an account prepared by Augustin Navarrete, a former secretary of the Sugar Producers Association of Porto Rico and from Doctor Wolcott's "Insectae Portoricensis," Journ. Dept. Agr. P. R., Vol. 7, No. 1, 1923.

of the Spanish colonization in 1509. Captain Gonzalo Fernandez de Oviedo who visited the island at that time mentions some of the insects common to Porto Rico, Santo Domingo, and Cuba in his "General and Natural History of the Indies."

Antonio de Herrera, in his "General Chronicle of the Indies," published in 1518, gives an extensive account of a plague of ants that ravaged the island in 1518. He describes in detail the measures used to control them.

Probably the first extensive account of the insect fauna of Porto Rico was given by Brother Iñigo, a priest known as the Abbot of the Sierra, who lived for many years in Porto Rico and in 1788 published his "Geographical, Civil, and Political History of the Island of San Juan Bautista de Puerto Rico." In chapter 35 entitled "Natural History of the Island of Porto Rico," he describes the life history and habits of many of the common insect pests of the island, including several species of ants, the common termite, the chigoe, the fire-fly or "cucubano," cockroaches, ticks, bees, wasps, etc.

The earliest recorded collection of insects in Porto Rico was made by Andres Pedro Ledru and is reported in his paper entitled (translated) "Journey to the Island of Porto Rico in the Year 1797," published in Paris in 1810. Doctor Wolcott states that, of the 46 species listed in this publication, 10 can be readily identified.

The next extensive account of insects of the island was published by Dr. Augustin Stahl, of Bayamon, Porto Rico, in a work entitled "Fauna de Puerto Rico." In this work, pages 82 to 102 discuss the systematic classification of insects, and pages 169 to 249 list the specimens in Stahl's collection from Cuba, Trinidad, and Porto Rico. This was published in 1882.

It seems also that a number of years before Stahl's paper, Dr. Leopoldo Krug, the German Consul at Mayaguez, had been collecting insects and that, at his invitation, the well known naturalist, Dr. Juan Gundlach, of Cuba, made two trips to Porto Rico and, with Krug, collected insects in various parts of the island. These collections were sent to Berlin for description and identification. As a result Gundlach, between May, 1887, and September, 1893, published the sections dealing with insects of his "Fauna Porto Ricqueña" in the Annals of the Spanish Society of Natural History at Madrid. The insects had been identified and described not only by German specialists but also by Saussure of Switzerland and Uhler of Baltimore.

When, following the Spanish-American War, Porto Rico was taken over by the United States, important advances on entomology, and

especially by the workers in economic entomology, were made. A Federal experiment station was started at Mayaguez, and the entomological workers at this station have published many important papers. Mr. O. W. Barrett held the position of Entomologist and Botanist from 1903 to 1905, Mr. W. V. Tower from 1906 to 1911, Dr. C. W. Hooker in 1912, Mr. R. H. Van Zwaluwenburg from 1914 to 1917, and Mr. Tower again from 1918 to 1924. These men have all been excellent entomologists and have done valuable work. In 1913, Dr. E. F. Phillips of the Federal Bureau of Entomology visited Porto Rico, at the invitation of the Porto Rico Experiment Station, and prepared a bulletin on Porto Rican bee-keeping, published as Bulletin 15 of the Station.

The Sugar Producers Association of Porto Rico started an experiment station at Rio Piedras in 1911, for the purpose of studying the problems of sugar cane growing. A year later the Board of Commissioners of Agriculture was created by the Porto Rican legislature, and a separate organization developed to study the agricultural problems of the island. In the years that followed, the entomological workers of both organizations did much cooperative work on the insect pests of sugar cane.

In 1914 the Board assumed charge of the work of the Sugar Producers Experiment Station and took over the entire staff. The combined organization was given the name of the Insular Experiment Station of the Department of Agriculture and Labor, the name under which it is now known.

Mr. D. L. Van Dine was the first Entomologist of the Sugar Producers Experiment Station, holding that position from 1910 to 1913 when he resigned and Mr. T. H. Jones, his assistant took charge. Mr. W. V. Tower was appointed Entomologist for the Board of Commissioners of Agriculture at the time of its creation in 1911. He retained this position until 1914 when the two stations were combined. He was then made Director of the Insular Experiment Station, and Mr. T. H. Jones became chief Entomologist. With this Station Messrs. C. E. Hood, S. S. Crossman, G. N. Wolcott, E. G. Smyth, G. B. Merrill, R. T. Cotton, J. D. Moore, F. Sein, Jr., and H. L. Dozier have also been connected. Doctor Wolcott has been connected with the entomological work of the Station longer than any other worker. Appointed as a traveling entomologist in 1912 to aid in the work of introducing parasites of sugar cane insects, he was promoted to the position of Chief Entomologist in 1914. He resigned in 1916 but returned in 1921 and resumed charge of the work until 1924. Dr. M. D. Leonard is now Chief Entomologist.

The insect pests of the sugar cane provide the most important entomological problems of the island, and the effort of a majority of the workers of the two stations have been directed towards solving these problems.¹ The major pests of tobacco, Citrus fruits, vegetables, coffee, pineapples, and cotton have been studied, however, and are the subjects of numerous publications. The comparatively recent discovery that the mosaic disease of sugar cane is carried by *Aphis maidis* increases the importance of entomological work in the island.

In 1925, Mr. Harold E. Box, an Englishman who had been doing work in British Guiana, was made Entomologist to the Central Aguirre Sugar Company of Porto Rico, and held the post for rather more than two years, working mainly with the subject of sugar cane borer control. While holding this position he visited Santo Domingo and British Guiana and spent some time in Venezuela searching for appropriate parasites for Porto Rico. In May, 1927, he joined the staff of the Agricultural Experiment Station at Tucuman, Argentina, where he has remained and where his main problem has been the sugar cane borer. Mr. Herbert Osborn, Jr., succeeded Mr. Box in Porto Rico.

Added note.—A natural history survey of Porto Rico and the Virgin Islands has been conducted by the New York Academy of Sciences and its results are now being published in cooperation with the Government of Porto Rico. Volumes 11, 12, and 13 of this extensive series of reports will be devoted to insects. Four portions of Volumes 11 and 12 are in preparation as follows: The Diptera, by C. H. Curran; the Heterocera (exclusive of the Geometridae and Microlepidoptera), by William T. M. Forbes; The Geometridae and Microlepidoptera, by William Schaus; the Rhopalocera, by F. E. Watson.

HAITI

The natural history of Haiti has been of great interest to a number of naturalists, particularly during recent years. As a zoological field, it possesses an interest possibly foremost in character among the West Indian islands. The birds have been studied by James Bond and Alexander Wetmore; the Mollusca by Paul Bartsch and the late C. R. Orcutt; the Reptilia by Thomas Barbour and Miss Doris Cochran; and Dr. William Beebe and his staff have studied the fishes, sponges and other forms of the Port-au-Prince Bay.

¹ As late as 1928 Doctor Wolcott read an important paper before the Fourth International Congress of Entomology which was entitled "Weather and the Non-burning of Trash in Borer Control in Porto Rico." This was published in the proceedings of the Congress.

In 1923 a branch of the Government service known as the (translated) Technical Service of the Department of Agriculture and of Professional Instruction was established. Dr. George F. Freeman, from the United States, was appointed Director General of this Service. The technical work was organized under three divisions, and Dr. George N. Wolcott was made head of the Department of Entomology and Entomologist of the Experiment Station. He served from July, 1924, to March, 1928. Entomological problems were taken up, and the following native Haitians were engaged in the different problems: Marcel Dartiguenave, Adonis Muller, Emanuel Ducasse, Andre Audant, Alphonse Noel, Auguste Daumec, and Ernest Guéry. In July, 1928, Doctor Wolcott was succeeded by Dr. Roger C. Smith, who had been, with Dr. George A. Dean, a professor in the Agricultural College of Kansas. In January, 1929, Doctor Smith was made Director of the Central School in addition to Department work, and in the later months of 1929 was Acting Assistant Director General. Five projects were begun during his administration, namely (1) Cotton insects; (2) Insects affecting staple crops other than cotton; (3) Fruit and vegetable insects; (4) Insects and rodents injurious to man; (5) Bee culture. Much time was also devoted to the making of an insect pest survey of Haiti and to the bringing together of a representative collection of identified insects as a basis for instruction work in the Central School. Doctor Smith completed his work in the winter of 1929-30, and returned in the spring of 1930 to Kansas.

Dr. H. L. Dozier succeeded Doctor Smith as the head of the department in the Technical Service on October 1, 1929. Doctor Dozier had served in Porto Rico and later occupied the post of Entomologist of the Delaware Agricultural Experiment Station.

Doctor Smith informs me that the Department has a good equipment for the usual entomological work, and that the zoological library is probably the best of any in the technical branches.

Doctor Wolcott, in beginning his work in 1924, took up especially insect enemies of sugar cane and cotton. The pink bollworm was found to occur in certain regions and particularly with certain varieties of cotton. In 1926 the International Institute of Rome published a report by Mr. Wolcott on insect pests in Haiti. In 1927, a very well done book of 440 pages was published by the Technical Service at Port-au-Prince, on the entomology of Haiti, under the authorship of Doctor Wolcott. It is written in the French language, of course, and carries 133 figures of which a number are original and are very well done. They were drawn by Fritz Maximilien, a former student of the Central Agricultural School and employed as an assistant in the

Technical Service. At the Fourth International Congress of Entomology in August, 1928, at Ithaca, New York, Dr. Wolcott read an interesting paper entitled "The Pink Bollworm in Haiti," which will be found in the Proceedings of the Congress.

THE DOMINICAN REPUBLIC

Some work was done in the Dominican Republic prior to 1920 by O. W. Barrett and E. A. Barthe, and in 1919 there was published in the *Agricultural Review of Santo Domingo* an article on the economic importance of the sweet potato weevil by M. A. Crespo. In 1920 George N. Wolcott was appointed to the National Agricultural Station of Haina. Mr. Wolcott's term of office was short and he seems to have published nothing at the time, but some years later, while in Porto Rico, he published an article on the insects that attack cacao in Santo Domingo. In 1927 Dr. Giuseppe Russo began to publish as Chief of the Entomological Section of the National Agronomical Station and College of Agriculture. He has written a short pamphlet on the insects injurious to the principal cultures and the methods of fighting them, and especial articles on the insects of various crops, and also upon apiculture and honey. In a magazine entitled *Revista de Agricultura*, the official organ of the Department of Agriculture, of which I have seen several of the 1929 numbers, Doctor Russo has good articles upon a number of entomological topics. Early in 1929 Dr. Juan Gomez Menor was appointed to the Service of Plant Sanitation of the governmental Department of Agriculture. He has published an article on the Mediterranean fruit-fly and two on the biology of scale insects.

VIRGIN ISLANDS

Soon after the United States Government purchased the Virgin Islands from Denmark in 1917, an Agricultural Experiment Station was started; and Mr. C. E. Wilson was appointed Entomologist in April, 1919. He served until August, 1922. He published notes on the insects of the Virgin Islands and means for their control, in the reports of the Station from 1920 to 1923, and among these notes an extensive list of scale insects. He was also the author of a bulletin (No. 3) on the insect pests of cotton in St. Croix, and of one (No. 4) on truck crop pests in the Virgin Islands. Other articles containing insect notes were published under the authorship of L. Smith.

PART VII

MEDICAL ENTOMOLOGY

THE INTERNATIONAL USE OF PARASITES

OTHER MATTERS

MEDICAL ENTOMOLOGY

It will be remembered that, in our consideration of economic entomology in North America, in Part I, we devoted some time to the consideration of the extraordinary events of the last decade of the nineteenth century which served to focus universal attention on applied entomology. One of those events was the proof of the carriage of disease to human beings by insects. That, however, was a discovery by no means confined to America, and was not only of world-wide importance, but investigations in that direction were begun immediately by men in all parts of the world. It therefore deserves consideration in a section that will not be limited geographically.

Medical entomology, although so important today, extending as it does in numerous directions, is of very recent development. The first exact proofs of the carriage by insects of disease organisms was gained less than 50 years ago. It is true that here and there suggestions had been made as to the rôle of insects in the carriage of disease for many years previously. The idea seems to have sprung up and gained ground among the aboriginal peoples of India, Africa, and South America; and even on the Roman campagna, a home of malaria, the poor peasants long ago connected the idea of mosquitoes with the idea of fevers. And nearly a hundred years ago two medical men, Dr. Josiah Nott, of Mobile, and Dr. Louis D. Beauperthuy, of the West Indies, argued that mosquitoes were instrumental in the carriage of yellow fever.

But all this was before the era when the medical world learned, through Pasteur and his school, that the old humoral and vitalistic doctrines concerning disease were wrong, and that a great number of diseases have as their only causes infinitely minute beings of both animal and vegetable nature which penetrate the bodies of warm-blooded animals and produce not only specific lesions but general disease. The Pasteur discoveries related only to bacteria. He was followed by hundreds of workers who showed that other parasitic organisms exist and that these organisms are excessively variable in type, in biology, and in resulting diseases. Some of the higher of these forms—the parasitic worms—were discovered before Pasteur; and the first parasitic Protozoan, causing dysentery, was found a few years before Pasteur's bacterial discoveries were announced. And then followed the discovery of the Spirochaete of relapsing fever, the Ameba of tropical dysentery, the Protozoan cause of malaria, the

Trypanosome of sleeping sickness, the Leishman bodies of kala-azar, the Spirochaete of syphilis, and others.

The first discovery which implicated insects as carriers was the finding by Sir Patrick Manson in 1879 of the rôle of the mosquito, *Culex fatigans*, in the development and carriage of filarial worms. The second was the discovery by Theobald Smith in 1889 to 1891 of the carriage of the causative microorganism of Texas fever of cattle by a tick. The third was the discovery by Sir (then Major) Ronald Ross in 1898 of the carriage of malaria by *Anopheles* mosquitoes. The fourth was that by Reed, Carroll, Lazear, and Agramonte of the carriage of yellow fever by the mosquito, *Aedes aegypti* (then known as *Stegomyia fasciata*). The fifth was the discovery by Graham in Syria that dengue fever is carried by mosquitoes. Then followed the discoveries of the carriage of certain spirochaete diseases by ticks, the carriage of a fatal disease of cattle in Africa by tsetse flies, and the carriage of sleeping sickness in Africa by tsetse flies.

In all of these diseases, insects or ticks were found to be necessary secondary hosts of the parasitic organisms, but along with these discoveries were others in which insects were shown to be mechanical carriers of disease. Among these were the carriage of bubonic plague by fleas, typhoid or enteric fever by the house fly, typhus fever by lice, and so on.

Practically all of these discoveries were made by medical men, but they indicated in a most striking way the value of entomological knowledge. They gave an entirely new aspect to the study of entomology, and it is not to be wondered at that the skilled entomologists at once turned their attention to the groups of insects that were involved. At first the medical men seemed to feel that entomology was after all a rather simple thing and that it would be easy for them to handle the whole field thus developed. But it has become obvious that to secure the best results men trained in economic entomology and broadly trained in the biology of insects are of the utmost importance. One way to control the disease is to control the insect that carries it; hence, men trained in the control of insects are the ones to do the work to best advantage.

The greater importance of insect-borne diseases in the Tropics was early recognized, and England's great colonial possessions justified and in fact necessitated the founding of the great schools of tropical medicine at Liverpool and London. A similar school was founded later at Hamburg by the German Government, but the loss of her tropical possessions has minimized the later work at this institution.

The work at Liverpool was greatly facilitated by the employment of Robert Newstead as professor of entomology. That at Hamburg was strengthened by the addition of Dr. Erich Martini, a medical man trained in entomology, to the research staff. There was early established in Rio de Janeiro the Oswaldo Cruz Institute, where two trained entomologists, Dr. Adolfo Lutz and Dr. Arturo Neiva, have been working. Departments of medical entomology have been established in several American colleges, notably at Harvard, at Cornell University, at the University of California, and at the University of Minnesota. Books have been written, periodicals have been started, and the enormous and promising field is rapidly being exploited. The effect of the discoveries on public health is very apparent. Thousands upon thousands of lives have already been saved as their result. The intensity of many great scourges has been relieved. One of them, yellow fever, has measurably become a thing of the past. The work in this direction regarding the Tropics has shown that tropical countries may be inhabited safely by the white race, and what that means for the future of the world no one can now estimate. All over the United States even—a country which is, fortunately, for the most part situated in the healthiest of climates—life on the average is longer and happier because of the knowledge that has been gained regarding insect-borne diseases.

But this book is historical. The history of medical entomology has been treated more or less fully in a number of different text-books and general volumes that have been published. The writer in 1921 wrote "A Fifty-Year Sketch History of Medical Entomology" which was published in the Jubilee Volume of the American Public Health Association and reprinted, with some change, in the Smithsonian Report for 1921. So the main features of the history of the subject (which after all is so recent) have been covered in an accessible way.

It will possibly be of interest, however, to add some facts from the personal experiences of the writer.

Having had more or less of a medical education and being, therefore, interested in medical subjects, this new development of entomology naturally appealed to me. And then chance led to the study of mosquitoes, house flies, and fleas in the preparation of a work on household insects in 1895 and 1896 before any of these insects had been implicated in the carriage of disease. In fact, mosquito remedies had been studied by us even before this. I had used kerosene in a water trough when a boy at Ithaca as early as 1867, and in the summer of 1892 conducted a series of careful experiments in the use of kerosene on a mosquito-breeding pond, determining the spread qualities

and film durability of illuminating oil (Insect Life, Vol. 5, pp. 12-14). In the earlier volumes of Insect Life, drainage, and the use of kerosene and fish that feed on mosquito larvae were recommended.

In 1896 the bulletin on insects of the household was published (Bulletin No. 4, new series, Division of Entomology, United States Department of Agriculture) containing chapters on mosquitoes, house flies, and fleas by the writer, and on bedbugs and cockroaches (as well as other domestic insects) by C. L. Marlatt. These chapters included original observations on life histories, and pointed out remedies.

After the publication of the Insect Life articles, which received considerable newspaper publicity, there was much correspondence on the subject of mosquitoes, and this correspondence became even larger after Bulletin 4 was issued. The importance of Ross' discoveries in India was early appreciated, and by 1899 this work and that of Grassi, Bignami, and Bastianelli in Italy were becoming well known through notices in the medical journals.

In 1899, G. H. F. Nuttall's large and extremely important paper entitled "On the Rôle of Insects, Arachnids, and Myriapods as Carriers in the Spread of Bacterial and Parasitic Diseases of Man and Animals—A Critical and Historical Study" was published as Volume 8 of the Johns Hopkins Hospital Reports. The term "exhaustive research" is overworked, but that is the sort of thing Nuttall did in preparing this paper. Its publication placed those of us who were prepared and anxious to enter the new and immensely important field in possession of a full and careful account not only of all previous work but of all published theories and guesses. It was far from being a mere compilation. Had it been only a compilation, the thoroughness with which it was done would have made it invaluable. But it was a skilled study by a skilled parasitologist of the highest training in which he digested and contrasted the views of previous authors, critically examined their statements and proofs, and introduced new statements gained from correspondence or from his own observations.

I had already worked out and published three or four years before the full life history of *Culex quinquefasciatus* (I called it *C. pungens*), and I was anxious above most things to study Anopheles. The genus Anopheles was known to the men who studied Diptera. It was described by Meigen as early as 1818, and a North American species—*Anopheles quadrimaculatus*—was described by Thomas Say in 1824. His specimens came from the Northwest Territory. The type of Meigen's genus was *A. maculipennis*. Say, in his description, states that his new species is closely allied to *maculipennis*. In 1823 Say had

described *Culex punctipennis*, which he said was common on the Mississippi and that he had observed it in considerable numbers on the Eastern Shore of Maryland. Following his description of *A. quadrimaculatus* a year later, he stated that he had been informed by Wiedemann that his *Culex punctipennis* was a true *Anopheles*.

We had been collecting mosquitoes with much assiduity for some time, and were fortunate in having associated with us Mr. D. W. Coquillett, a very well informed dipterologist. In the late spring of 1900, Mr. F. C. Pratt, of the office, brought in from his home across the Potomac in Virginia not far from Alexandria some living mosquitoes that had been annoying him and which, he noticed, differed not only in appearance from those that he well knew but also in their humming note which, he said, was distinctly lower in the harmonic scale than that of the other mosquitoes. Mr. Coquillett recognized this form as *Anopheles quadrimaculatus*, and gravid females were confined in breeding-jars, and immediately deposited their eggs. During the following weeks I kept these jars in my office and was able to follow the transformations of the species for a complete generation and have competent figures made of the different stages by Miss Sullivan.

So great was the interest at that time in the malarial discoveries that I published at once an account of the transformations, with illustrations, in the Scientific American for July 7. Earlier in the season, by invitation, I attended the annual meeting of the American Medical Association at Atlantic City, and gave a paper on malarial mosquitoes before the section on the theory and practice of medicine, illustrating it with lantern-slides. The paper excited much interest and an active discussion.

Bringing together all the facts that had accumulated in the office and laboratories about mosquitoes, I prepared that summer Bulletin 25, new series, entitled "Notes on the Mosquitoes of the United States: Giving Some Account of Their Structure and Biology, with Remarks on Remedies," and this bulletin was published in a large edition to meet a very great popular demand. Fortunately it appeared in time to be used by Gorgas and LePrince in their clean-up of Habana.

In the spring of 1901, following a year of much activity in working, writing, and lecturing on the subject, I prepared the volume entitled "Mosquitoes: How They Live; How They Carry Disease; How They Are Classified; How They May Be Destroyed." The volume was promptly published by McClure, Phillips & Co. of New York, and was widely read. Surgeon General Sternberg had a large

number of copies bought for the use of the Army surgeons, and there seems no doubt that it was published at a psychological moment. Just before this book was published the Century Magazine published an article of mine entitled "Malaria and Certain Mosquitoes" (April, 1901).

There was one rather unfortunate episode connected with the publication of the book. It had not been out two days before I was told by a friend that Dr. Walter Reed's friends felt hurt by the way I had told the yellow-fever story. I had often talked with General Sternberg during the progress of the work of the Yellow Fever Commission in Habana. In fact, we met almost daily at the Cosmos Club, and he told me of his latest news from Reed or I told him of some letter that I had received from him. I thought that I was familiar with the situation, and stated in the book that the Commission had been appointed by General Sternberg and instructed by him to investigate the disease from the mosquito standpoint.

It seems that this was not the case. Their instructions were general and not specific. The mosquito investigation was undertaken on Reed's sole initiative. As a matter of fact, before going to Cuba for their work, Reed and Lazear spent some time in my office studying mosquitoes in order that they might most easily identify the old "*Culex fasciatus*" with which Carlos Finlay of Habana had done his earlier work; and during their investigations Reed frequently wrote me and sent me mosquitoes for examination.

When I learned that my phraseology had been criticised, I at once called on Reed and found him in an office in the Army Medical Museum. He was rather solemn, though perfectly courteous and friendly, and when I had made my explanation he said "That is how I thought it happened, but as a matter of fact I went into this line of work without instructions." And he went on to tell me that he had been doing some work at Johns Hopkins University and had often talked with W. S. Thayer who had visited Italy and studied the Anopheles-malaria work there and had therefore become anxious to do experimental work with yellow fever and mosquitoes.

I did the best I could under the circumstances, and wrote an article which was published in the American monthly Review of Reviews for August, 1901, and which was entitled "Mosquitoes as Transmitters of Disease." In this article I omitted all reference to instructions from the Surgeon General's Office and gave to Major Reed the whole credit for the inauguration of the work. I followed this with another article "Yellow Fever and Mosquitoes," in the Century Magazine for October, 1903.

This interest in mosquitoes naturally brought me into correspondence with Ronald Ross. One of his characteristic early letters (dated Liverpool School of Tropical Medicine, February 20, 1902) is of sufficient interest to quote:

I am delighted to hear that you like my "Mosquito Brigades." However it is not a patch on your work, which I wish I had got hold of before. I sail for Sierra Leone in two days, and hope to find work progressing. We have forced the Gambia Colony to take up the same work, and by dint of constant driving, I think we are getting this old country to do something at last. It is however doubtless the example of Havana that has chiefly set them going. We never do anything here unless some other country takes it up first. Yes, I think that the Italian School requires a little medicine in the shape of plain speaking. I suppose that you have seen the last effort of Grassi and Noe, who pretend that they have found out about *Filaria bancrofti*. As a matter of fact they have hardly ever seen one, much less found out anything about them.

Believe me,

Yours very sincerely,

RONALD ROSS.

In the summer of 1904 Ross came to the United States to take part in the International Congress of Arts and Sciences which was held under the auspices of the St. Louis Exposition. I saw a great deal of him at that time, and he seized the opportunity on the trip to visit Panama and look into Gorgas' great sanitary operations. In later years I visited him several times in Liverpool, saw him in 1912 at the 250th anniversary of the founding of the Royal Society, and in 1927 visited him at his home near London.

Following Ross' work in India, the Rt. Hon. Joseph Chamberlain requested the Royal Society of England to appoint a committee to cooperate with the officials of the Colonial Office in the investigation of the causes of malaria and the possibility of controlling that scourge of tropical lands. Prof. E. Ray Lankester, of the British Museum of Natural History, was appointed a member of the committee, and came to the conclusion that a most important service might be rendered in the preparation of a work describing the mosquitoes of all parts of the world so as to enable medical men engaged in tracing connection between mosquitoes and human disease to identify and speak with precision of the species implicated. As it happened, the collection of mosquitoes in the British Museum of Natural History was small, and the result was that with the help of the Colonial Office, the Foreign Office, and the India Office, circulars were sent out to the colonies, and a very large series of mosquitoes from all parts of the world was secured. The committee then secured the services of Mr. F. V. Theobald, who plunged into the monographic work. It is extraordinary that Mr. Theobald was able to do

such an enormous amount of work in so brief a time. Three volumes were published in 1901, one in 1903, one in 1907, and one in 1910.

Even earlier than the publication of Theobald's first volume, there was issued in London privately a volume of 374 pages by Maj. George M. Giles entitled "A Handbook of the Gnats or Mosquitoes" which had been brought together with much care but at the same time with much expedition to fill the need which was at once obvious. Major Giles made an extensive study of the literature and brought together in English descriptions of all of the mosquitoes which had been described down to that time. Later (in 1902) a second edition, rewritten and much enlarged, was published.

Realizing that neither Theobald's work nor that of Giles had probably been based upon competent material from North and Central America and the West Indies, I applied in 1902 to the recently founded Carnegie Institution of Washington for a grant which should enable the preparation of a monograph to include all possible information concerning all the mosquitoes of the geographical regions just mentioned. The grant requested was made by the trustees of the Institution in January, 1903, and organization work was begun at once. It was at first expected that the monograph could be completed in three years, and the grants made by the Institution covered that period. At the expiration of the third year, however, it was found that the material was by no means complete. Too much reliance had been placed upon promises of volunteer observers, and important regions were for this reason not properly covered. The writer had the good fortune to have Dr. H. G. Dyar and Mr. Knab associate themselves with him in this work; and at the expiration of the three years we were not content to publish the material accumulated, since it was our earnest desire to make the work as complete as possible and as valuable as possible to biologists and to sanitarians. The investigations were therefore continued during 1906, 1907 and 1908, partly by the help of funds appropriated to the United States Department of Agriculture by Congress for the investigation of insects affecting the health of man and animals, partly by the assistance of the Isthmian Canal Commission, partly by the help of volunteer observers in the West Indies and Central America, and partly at the expense of two of the authors (Doctor Dyar and Mr. Knab). Perhaps it was for the best that the first two volumes were not published until 1912, the third in 1915 and the fourth in 1917, but it seems rather sad to contrast this delay with the promptness with which Mr. Theobald's and Major Giles' works were put out. There can be no doubt, however,

that the monograph gained greatly by the delay and that it has been of much use. Activity in mosquito work has been so great, however, that it has become necessary to revise and extend the taxonomic portions, which fortunately has been done by Doctor Dyar and was published by the Carnegie Institution of Washington in a single large volume in May, 1928.

In 1902, while in England, I spent a week-end with Professor Theobald at his charming home at Wye (Kent). We had an extremely interesting time talking about mosquitoes and other things. We discussed, for example, the rather interesting question of authority in nomenclature. As it happens, he had sent me in correspondence his new generic name *Stegomyia* for the old *Culex fasciatus*—the yellow fever mosquito—and I had published it in my 1901 book, with excellent illustrations. His own volume did not appear until after mine, and he quite strenuously argued that the genus would be accredited to me and not to him. I am glad that it was not, since it is rather an awkward word, even if it has become implanted into (especially) medical literature.

This reminds me that in June, 1912, when I entered the big hall of Burlington House in London, on the occasion of the celebration of the 250th anniversary of the founding of the Royal Society the first person I saw was Ross. I advanced exuberantly, but he put his hands behind him and said, "I will not shake hands with you until you tell me that you chaps in Washington are not going to change the name of the yellow fever mosquito again." I regretfully confessed that Dyar and Knab had recently decided that the name should be changed from *calopus* Meigen to *aegypti* Linnaeus; whereupon he called out to Lt. Col. Alcock and Lt. Col. Skinner, "Here, boys, lock the doors and send for a bobby; we have got this Washington man here and we will keep him until he promises that that name will not be changed."

The publication of the bulletin on household insects (Bulletin No. 4, 1896) interested us once more in the subject of the house fly. I was not surprised to find that the full life history of this commonest of all insects had not been studied with much care. The information from Europe was scanty, and in this country Dr. A. S. Packard had described the rearing of one generation in 1873 at Salem, Massachusetts.

When it came to the preparation of the manuscript for Bulletin 4 on household insects, it was obvious that the house fly should receive careful treatment, and therefore in 1895 rearing experiments were begun. It was unexpectedly found that it was rather a difficult insect to rear in confinement, and in fact we were unable to get it to lay its

eggs on anything except fresh horse manure. Nevertheless, rearings in this substance were carried out during the summer, and the first rather full account of the species, since Packard, was published. Not content with this, however, further rearings were made during the following years, and experiments were made in the control of house-fly breeding in stables, since it had become our conviction that the horse stables, then so exceedingly numerous in cities, furnished the principal house-fly supply. While kerosene and chlorid of lime were found to be effective, especially prepared receptacles for manure attached to stables were found to be equally effective, and were recommended in Bulletin 10 (1898).

It is interesting to note that in the 1896 bulletin, with the idea in mind that horse manure was by far the principal breeding place, the prediction was made that with the "lessening of the numbers of horses and horse stables consequent upon electric street railways and bicycles, and probably horseless carriages," the time would come when house flies would cease to be a nuisance. It will be remembered that the horseless carriage at that time was an extremely rare object.

While suggestions as to the carriage of disease by the house fly had been made at intervals for very many years, it was not until the short war between the United States and Spain, in 1898, that the prevalence of typhoid fever in concentration camps brought about the appointment of an Army typhoid commission which concluded that flies undoubtedly serve as carriers of the infection. This conclusion intensified interest in the house fly. Further experiments had shown that, under certain conditions, this insect will breed in a variety of fermenting organic material, including human excreta, and the constant possibility of infection of food supplies by contaminated house flies was obvious. I therefore planned an elaborate series of experiments which resulted in the publication in December, 1900, of a lengthy article entitled "A Contribution to the Study of the Insect Fauna of Human Excrement [With Especial Reference to the Spread of Typhoid Fever by Flies]"—*Proceedings, Washington Academy of Sciences*, Volume 2, pp. 541-604, 21 text figures, 2 plates.

In the years following 1900, the house fly as a disease spreader received an enormous notoriety. Newspapers and other publications contained many articles on the subject. Women's clubs and other citizens' organizations in a gradually increasing number of towns and cities and health officials here and there took up the question seriously until it became evident that in the United States a very general crusade against the insect was under way.

I believe it was Doctor Krumbhaar, of Kansas, who coined the not very pleasant but very expressive slogan "swat the fly," and many communities offered prizes to the school children bringing in the greatest number of "swatted" flies, much to the distress of some of the tender-hearted members of the Society for the Prevention of Cruelty to Animals. These campaigns were of educative value although the destruction of the adult flies had probably only a slight effect on the fly population. Nevertheless, people came to know the danger of flies and to learn how and where they breed.

During these years I published many articles on the subject and gave a number of public lectures, and other people were doing the same. In 1910 I prepared a book which was published by F. A. Stokes & Company, of New York, early in 1911 under the title "The House Fly, Disease Carrier; an Account of Its Dangerous Activities and the Means of Destroying It." An edition of this book was published simultaneously by John Murray in London, and it was subsequently reprinted in a number of countries and in a number of different languages.

England had in the meantime become exercised on the subject of this insect, although at no time in England have I known the house fly to abound as it did formerly almost everywhere in the United States. It happened, however, that only a very few years after our own disastrous experiences with the house fly as a carrier of typhoid in our concentration camps at the time of the Spanish War, England found herself at war in South Africa, and our own experience was repeated there. Enteric fever (as they call typhoid in England) was responsible for a large loss of life, and its carriage was obviously due in great part to flies. So at home the English began to study the question. The London County Council took it up through its health officers, and a number of small but very useful pamphlets were published. C. Gordon Hewitt, then a professor in the University of Manchester, began to study the house fly very carefully; and Dr. G. S. Graham-Smith, of the University of Cambridge, in the "Cambridge Public Health Series," prepared and published two volumes on "Flies in Relation to Disease."

When the success of anti-typhoid inoculation became evident shortly before we entered the World War, one of the great dangers from house flies seemed to have been removed, and there was apparently a slowing down of many of the fly campaigns. Other diseases, however, may be carried by flies, notably infantile diarrhea, and there was abundant justification for the continuance of the strenuous movement started in the early part of the century.

As indicated in a previous paragraph, owing to the extraordinary increase in the number of horseless vehicles and the consequent enormous decrease in the number of horses in cities and towns, the house fly problem is by no means as great as it was even a few years ago. The health departments of even small towns understand the best means for preventing the breeding of flies, and even in the country where horses are still used the problem is by no means as great as it was formerly.

All this refers to the United States. In certain other countries the situation is different, and the house fly still exists in enormous numbers and still carries pathogenic organisms to exposed food supplies. Within a week (it is now May 14, 1928) I saw that the Italian Government had decided to institute mandatory regulations for the abolition of all possible breeding places.

The Bureau of Entomology of the United States Department of Agriculture, having a large staff of trained entomologists who have immediate access to very large collections and libraries, has naturally been appealed to in numerous directions in this field of medical entomology and in veterinary entomology as well. The advantages of enlisting the services of this organization were so obvious that as early as 1904 the writer, as Chief of the Bureau, was made official Consulting Entomologist to the United States Public Health Service, and later Senior Entomologist with the grade of Senior Surgeon in the United States Public Health Service Reserve. Also, during the World War he was made chairman of the subcommittee on medical entomology of the National Research Council.

The work of the Bureau against the cotton boll weevil in Texas in the early days brought the field men into contact with the extensive live stock industry, and they were appealed to for information on several live stock problems in which insects were concerned. A little later certain important cotton men applied for information as to malaria under plantation conditions in the Mississippi delta. As a result, Congress made a small appropriation of \$10,000 a year to the Bureau for "investigation of insects affecting the health of man and animals." Under this appropriation some work was carried on for a time on the Rocky Mountain spotted fever in Montana, and for many years important work on malaria and the control of its vector under large plantation conditions has been going on with headquarters at Mound, Louisiana. And at the same time investigations have been made on certain important live stock insects. For many years this work was done under the immediate direction of Dr. W. D. Hunter, who at the same time directed the work against southern field crop

insects. After his death in 1925 the health-insect work was taken over by Mr. F. C. Bishopp, the part relating to malaria remaining in charge of Dr. W. V. King who had succeeded the original appointee at Mound, Capt. D. L. Van Dine.

Quite recently Dr. G. F. White and Dr. W. E. Dove of the Bureau have investigated the cause of creeping eruption in Florida, discovering that it is not due as had been supposed to a larval insect but to a nematode worm.

All through this period the Bureau, in this work, has been in a somewhat ambiguous position. Live stock work belongs to the Bureau of Animal Industry of the Department of Agriculture. All work relating to public health belongs to the United States Public Health Service. At the same time, it was felt that the Bureau could make important contributions, with its force specifically trained in economic entomology.

The World War brought about great and immediate stimulus to the study of medical entomology. The necessity for the services of entomologists was appreciated by the warring nations in Europe at a considerably earlier date than in this country, but later the entomologists over here were drawn in and important work was carried on in cooperation with the office of the Surgeon General of the Army and with the Committee on Medicine of the National Research Council. A number of entomologists were drawn into the Army, largely for work in connection with the health of the troops in concentration encampments on this side, and in several of these great concentration camps entomologists were placed in entire charge of matters of mosquito and fly control, under medical command or under sanitary engineers. I have gone into the matter of entomology and the war rather extensively in an article under this title published in the *Scientific Monthly* for February, 1919, and reprinted in the *Smithsonian Report* for that year.

Following the war, a number of articles and several books were published describing the details of procedure in malaria control at various points near the front and in concentration camps. A good example of these papers is a small book by Willoughby and Cassidy, of the British service, entitled "Antimalaria Work in Macedonia Among British Troops" (H. K. Lewis & Co., Ltd., London, 1919). It is interesting to note that in this book is stressed the importance of the choice of camp sites for the many troops not actually in the front line. This is an interesting contrast to the deliberate choice by the medical authorities of our own Army of many concentration camps in this country in notorious mosquito and malarious regions.

This was due probably to Surgeon General Gorgas' confidence in his ability to control mosquito breeding, based upon his successful work in Habana and the Panama Canal.

Entomology links up in a way with another medical matter of great importance. Early in the century, the danger in the use of bisulphide of carbon as a fumigant for stored grain to kill grain weevils of different kinds became so very apparent that it attracted the earnest attention of the fire insurance companies. The Bureau of Entomology, therefore, tried to get an efficient substitute which lacked this danger. Carbon tetrachlorid had been mentioned at that time in connection with fire-extinguisher work, and experiments were undertaken by F. H. Chittenden and C. H. Popenoe of the Bureau with the use of this substance against grain insects; and in 1911 a bulletin was published (Bureau of Entomology No. 96, Part 4), under the authorship of Chittenden and Popenoe, in which the results of their experiments were shown to have justified the use of this chemical in small compartments, although its expense would hardly justify its use in large buildings such as warehouses and mills.

Later, Dr. Maurice C. Hall, of the Bureau of Animal Industry, used carbon tetrachlorid with effect against intestinal worms in animals, and this chemical has since been used with admirable results against the hookworm in human beings. It is more effective than the old thymol and chenopodium and is infinitely more agreeable as a dose. It has been used on mass populations in several tropical countries, notably perhaps in Fiji. Dr. S. M. Lambert, in the *Journal of Tropical Medicine and Hygiene* (May 15, 1928), says of Hall's discovery, "I reckon this as the greatest contribution to tropical medicine after the work of Ross on malaria and the work of Reed *et al.* and Gorgas on yellow fever."

Thus the entomologists were indirectly concerned in another great contribution to human health.

From the rather rambling way in which we have treated medical entomology in this section, it is perfectly evident that the section is not to be considered as a definite history of medical entomology, but rather as a somewhat lengthy contribution to such a history. As previously stated, I have already published a paper entitled "A Fifty-Year Sketch History of Medical Entomology" which appeared in "A Half Century of Public Health—Jubilee Historical Volume of the American Public Health Association" (New York, 1921), pages 412-438. This was reprinted by the Smithsonian Institution in its Annual Report for 1921, pages 565-586, with ten portrait plates

(the plates do not appear in the Public Health volume). That paper brought the subject down to 1920, and it is comparatively easy to trace the subsequent advances and discoveries with the aid of several very competent review journals, especially the Review of Applied Entomology, Series B, Medical and Veterinary (London), and the Tropical Diseases Bulletin (London).

There is, however, one thing that I might touch upon to advantage since it fits in somewhat with personal experience. In September, 1927, I paid a visit to Sir Ronald Ross in England. He had been very ill (a stroke of some kind), but was very talkative and interesting. He vigorously inveighed against Grassi and his claim of originality in the discovery of the carriage of human malaria by *Anopheles*. As it happens, Grassi had talked to me with equal vigor in support of his claim, the last time I saw him in Rome, in 1925. Possibly there will always be followers of Grassi, but it seems to me that the Ross claim is perfectly just and that the Nobel Prize Committee was entirely sound when it awarded the prize to Ross. The story has quite recently been told in a very definite way by Dr. G. Carmichael Low in his presidential address before the Royal Society of Tropical Medicine on October 18, 1929 (see *The Lancet*, November 2, 1929, page 927). The review in *The Lancet* relates to that part of Doctor Low's address that deals with Sir Patrick Manson, but includes a long section on "Malaria and Mosquitoes." It seems that Ross had studied malaria in Bangalore in 1889 but had failed to confirm Laveran's discovery of the malaria parasites. In 1894, visiting Manson, he was shown the parasite. In August, 1897, Ross, in Secunderabad, found, in the stomachs of "spotted-winged mosquitoes" bred from larvae and fed on a patient with malaria crescents in the blood, certain cells containing pigment granules indistinguishable from those seen in malaria parasites; and a month later he found such cells in another species of *Anopheles*—also bred from larvae and fed on malarial blood. Very unfortunately, Ross was then sent to another part of India, but in January of 1898, by Manson's intercession, he was sent to Calcutta to continue his malaria research.¹ Human malaria was rare in Calcutta; so he turned to the malaria of birds, and found plenty of material. He then traced the cycle of the parasite's development in a *Culex* mosquito,

¹ Manson wrote Ross July 3, 1899, the following significant words: "Many thanks for the generous way you have recognized my small part in the malaria business. It is more than I deserved. My only claim is that in a measure I discovered you." (See *Journal of Tropical Medicine and Hygiene*, February 1, 1930, p. 38).

and his results were announced in July, 1898. As Doctor Low puts it, "But the 'mugwumps' had not finished with Ross." He was sent away, this time to Assam, to study kala-azar, and while he was gone Grassi, Bignami, and Bastianelli in Rome verified the discovery for human malaria and Anopheles. Doctor Low concludes, "This would not have been done at the time but for Ross' work—the Italian researches followed his, and were not independent of them."

Ross tells the story very effectively and rather at length in the first chapter of his big book "The Prevention of Malaria" (London, John Murray, 1910). This book carries 330 pages by Ross himself, followed by 330 more by special contributors, the latter part being accompanied by many plates. The writer furnished one of these contributions at Ross' request.

PERSONALIA

I have been very fortunate in meeting very many men who have accomplished things in medical entomology, not only in the United States but in other countries. I knew Dr. A. F. A. King very well. When he was filled with the idea of the relation between malaria and mosquitoes in the early 1880's and before he read his extended paper on this subject before the Philosophical Society of Washington (afterwards published in the *Popular Science Monthly*) he came down to the entomological offices in the Department of Agriculture and discussed the question at some length with Professor Riley and myself. I am sorry to say that we gave him no encouragement. The idea appeared to us to be altogether too farfetched. It is worth noting also (I have referred to it in my *Sketch History of Medical Entomology*) that when he read his paper before the Philosophical Society, although the late Dr. John S. Billings and Dr. Robert Fletcher, both very keen medical men, were there, there was no helpful discussion. Doctor King was a successful gynecologist and obstetrician who lectured at the Medical College of the Columbian University (now George Washington University) and acted as Registrar of the College.

Then too, I knew Theobald Smith. We were at Cornell together. While he was engaged upon his investigation of the cause of the cattle-tick disease we occasionally discussed the matter. His demonstrations (1889-1892) of intraglobular parasites in Texas fever and their transmission by the second generation of cattle tick was revolutionary in its character, but his results do not seem to have been known by Laveran or by Ross at the times when their discoveries were announced. This happens to have been the only work in connection with medical entomology that was done by Doctor Smith, but

his later accomplishments at the Harvard Medical College and at the Rockefeller Institution branch at Princeton have placed his name very high in the annals of medical research.

I have had the pleasure of knowing W. G. MacCallum who in 1889 published a paper in which the true function of the flagella in a certain stage of certain malarial organisms was first shown.

Years later I became well acquainted with Walter Reed, James Carroll, and Jesse W. Lazear. They came to the entomological offices in the Department of Agriculture to study mosquitoes before they went to Cuba where their immortal discoveries were made. During the progress of the Cuban work Walter Reed wrote me frequently for information about mosquito questions. Henry R. Carter, whose investigations had a strong bearing on the results reached by the Army Commission later became a friend and a frequent visitor to the Bureau of Entomology. Dr. J. H. White, of the United States Public Health Service, who had charge of the work in New Orleans during the epidemic of 1905 and who succeeded in stifling the epidemic in a most dramatic and spectacular manner by his intensive work against the yellow fever mosquito, was then well known to me. I visited New Orleans toward the close of his work, and since that time we have often talked over this and similar matters. The well known parasitologists, Dr. C. W. Stiles and Dr. H. B. Ward, are old and warm friends. Prof. R. W. Doane of Stanford University, who wrote the earliest American book on insects and disease, is also an old and valued friend. D. L. Van Dine, who began the first anti-mosquito work in Honolulu and who has since carried on some extremely fine malaria investigations for the Bureau of Entomology in Louisiana, has been a friend and associate for many years. The late General Gorgas and his right-hand sanitary engineer J. A. LePrince came to the Bureau of Entomology before they left for Panama, and corresponded with us for many years. One of the last letters that General Gorgas wrote before his lamented death in London was addressed to me in answer to one I had written to him inquiring as to the truth of the statement that he endorsed Doctor Campbell's ideas concerning bat roosts and malaria. His reply was to the effect that he did not endorse them. In his successful clean-up of Habana and his later work in Panama the remedial measures against mosquitoes published by the United States Bureau of Entomology in 1898 were used as a basis with later elaborations and details suggested by the fertile brain of Mr. LePrince. This assistance is acknowledged by Mr. LePrince in the book that he published later, in collaboration with Dr. A. J. Orenstein, entitled "Mosquito Control in Panama" (New York,

1916). The present excellent teachers and investigators, William A. Riley of the University of Minnesota, Robert Matheson of Cornell University, and W. B. Herms of the University of California, are warm friends of mine. I know Doctor Cort of Johns Hopkins, and wish that I knew him better. W. V. King, in charge of the important malaria work at Mound, Louisiana, of course, is a colleague and associate.

I have been almost equally fortunate in my association with English investigators. Sir Ronald Ross (then Major Ross) came to the United States in December, 1903, to attend the meeting of the American Association for the Advancement of Science held in December 1893-January 1894. He came as an invited guest, and read a paper dealing largely with the mathematics of malaria, which aroused much interest. We became friends at once, and I visited him in Liverpool at the School of Tropical Medicine two years later. During this visit we talked at length concerning mosquito work, and Prof. Rubert Boyce (afterwards Sir Rubert) discussed with us the advisability of recommending Dr. James Carroll, of the United States Army Yellow Fever Commission, as a candidate for the next Nobel Prize. I think Walter Reed would undoubtedly have received the prize had he lived, and, since Carroll was the only surviving American member of the Commission, it was thought that possibly the trustees of the Nobel fund should be urged to award the prize to him. It was decided, however, that Reed was without question the great moving spirit in the investigation, and that Carroll was only one of three willing subordinates, and that, although he was connected with the great discovery, he was not responsible for it. The intimacy of this discussion and the charming courtesy of Ross and Boyce, who in fact went with me to the steamer and stood on the dock waving farewells as the great vessel moved off, are delightful memories. In 1912, attending the 250th anniversary of the Royal Society as a delegate of the Washington Academy of Sciences, I met Ross again. In the intervening years he had been knighted and had received many other honors, but these had not altered his frank, open, friendly disposition or his delightful courtesy.

From that time on, Sir Ronald was much in the limelight, and, unfortunately, felt obliged to do much controversial writing. He fought very vigorously the claims of the Italian school and vigorously defended his own rights in his great discovery. However, the Ross Gate was dedicated in Calcutta, the Ross Institute near London was founded, and his name was known and honored all over the world. In 1927 he had a stroke, from which he had measurably recovered

when I called on him September 20th of that year in company with Malcolm E. MacGregor. We found him in a charming apartment at Putney Heath, sitting up and waiting for us. He looked strong and well colored, but his left side was nearly helpless. His speech was a shade thick, but he talked constantly and wanted us to drive with him in the park. He talked of the Ross Institute and wanted us to visit it. He showed us a big cabinet in which he had, systematically filed and indexed, all of the papers relating to his malaria work. He swore about the Italians, spoke of Grassi as a damned liar, but said that Celli was a good fellow and a gentleman. He spoke of De Kruiff's book, "The Microbe Hunters," with profanity. He talked much about the sale of his cabinet. He seemed nervous, and ran on from one subject to another, forgetting many names. He constantly reverted to the subject of tea and to the proposed drive and to Grassi and to his cabinet of documents. He gave us each a copy of his latest paper on the Grassi claims. He said he was going down to Gibraltar to visit his son-in-law, and also said that he would like to be invited to the International Congress of Entomology to occur in August, 1928.¹ He told us that his stroke was not caused by a bursting capillary but by a chalky stoppage of a blood vessel in his brain. He seemed pleased at this. He said that he could see the chalky deposits in some of his veins. On the whole it was a painful experience to see this splendid fellow whom I had known in his prime in 1904, 1907, and again in 1912, and with whom I had often corresponded (I wrote a chapter in his first big book on malaria), under this cloud.

When Ross left St. Louis early in 1904 he returned to New York and then sailed for Panama where he studied with interest the work of Gorgas in the Canal Zone. The following year (1905) Rubert Boyce, accompanied by Viscount Mountmorris, came to the United States. This was the year of the last New Orleans outbreak of yellow fever. Professor Boyce went down there and assisted as a volunteer in the work carried on so wonderfully by Dr. J. H. White. Subsequently he wrote a very interesting book entitled "Mosquito or Man?" in the course of which he gives a most admirable account of the New Orleans epidemic, printing the proclamations and notices that were issued in the course of the campaign, and closing his account with these quotable words: "Thus an outbreak which in previous years would have developed into the usual awful epidemic was in a few weeks at a comparatively small cost completely stopped, *and that in the face of a dense population, open drains, and a sultry summer.*" (The italics are mine.)

¹ An invitation was sent to him later, but there was no reply.

I have known for many years Prof. Robert Newstead (a dear and very able man), formerly the Entomologist of the Liverpool School of Tropical Medicine, and while visiting him have met most of the workers there, including J. W. W. Stephens and Warrington York. In London, I have known Lt. Col. A. Alcock, formerly head of the London School of Tropical Medicine, for whom I have a great admiration. And I have the same admiration for Dr. (now Sir) Andrew Balfour, formerly of the Wellcome Research Laboratories and now head of the London School. Sir Andrew is a very remarkable man—an investigator of the highest rank, an admirable administrator, a delightful public speaker and a very charming writer. It is not very well known among his friends that he is the Andrew Balfour who has written several mighty good novels. I accused him of this authorship once, and he replied that he had in former years, in his leisure moments, written some stories. I think it must have been good practice for him, for his public addresses and his occasional essays are models. One has just reached me. It is entitled "Health and Empire" and is a printing of "The Hastings Popular Lecture" delivered in the great hall of the British Medical Association on March 12, 1930.

Malcolm E. MacGregor, at one time a Carnegie Student in this country, and who married a charming American wife over here, has been connected with the Wellcome Laboratories since his return to England, and I count him one of my best friends. He did an admirable piece of work in his malaria investigation in Mauritius, and was one of the first writers to direct attention to the physical and chemical condition of mosquito breeding waters. Of course I know Maj. E. E. Austen and F. W. Edwards, distinguished dipterists of the British Museum of Natural History. Major Austen's study of the tsetse flies has been of great help in the African work against the sleeping sickness; and F. W. Edwards, with Dr. H. G. Dyar of Washington, has helped to keep the scientific world informed and sane on the subject of mosquito taxonomy.

Then too, I had the pleasure of knowing well Sir Arthur Shipley, one of the most delightful men I have met, keenly and charmingly humorous and of great ability as an investigator, writer and lecturer. As head of Christ College in Cambridge, his beautiful chambers were the evening resort of the choice spirits at the Darwin Centenary in 1908. During the World War, Shipley came to the United States at the head of a delegation of Englishmen for the avowed purpose of addressing representative audiences in principal cities concerning European conditions and the English attitude. They came to Wash-

ington in 1917 I think; and that was the last time I saw the dear, fine man, as he died not long afterward. Once in London, in inviting me to a dinner at his club, Shipley appended to his note of invitation the following:

You may not have noticed that the hookworm has been discovered in Cornwall. The discovery suggests these lines—

If Cornish saints worked miracles
The bishop of this diocese
Would quickly rid the Cornish mines
Of ankylostomiasis.

I shall always remember my meetings with Raphael Blanchard, who wrote the first French book on mosquitoes following Ross' epochal discovery. Blanchard was a great worker and a very impressive man. He was a great teacher. He was an orator and a most delightful companion. In his big mosquito book he used many of my illustrations, and I am very proud that he did so. It would be difficult to exaggerate Blanchard's personal charm, and yet he had, if not enemies, still scientific workers who apparently did not like him and his work. I found that in Paris some of the workers at the Institut Pasteur apparently did not approve of Blanchard. At all events, they did not seem to be on speaking terms. There was indeed something of the spectacular about him. It was not his fault; he was big, handsome and eloquent, and full of energy, and I imagine that one element in whatever antagonism existed might have been due to a slight admixture of envy and jealousy, perhaps unappreciated by those who were influenced by it. He was a great traveler (for a Frenchman), and he was a linguist (that too is rare among French scientific men). I remember meeting him once in Paris, and he invited me to dine with him at a famous restaurant. He had recently learned the English language, and, out of consideration for my indifferent French, he had invited a fine Frenchman and his wife, both of whom spoke English, to dine with us. During the dinner, Blanchard was called to the telephone, and while he was gone his French friend said, "Oh, Professeur Blanchard is a great voyageur; he has been in Russie, in Algerie, in Allemagne, and he speaks all the language, even the language of the États-Unis, and he has visit your country!" At this moment Blanchard returned from the telephone, and his friend said, "Oh, Professeur Blanchard, tell us of your visite to the États-Unis." To this Blanchard replied, "I will not, but I will tell you of my retour to France. We are arrive at Havre; we descend from the ship; we arrive at the quai. Behold, there was a railway train. I regard. I say to myself, 'Can it be posseeble that that is a railway train? No, it is not posseeble; it is a toy for the children.' We enter

that train. We proceed into la France. I regard through the fenêtre. I say, 'Is it possible that this is agriculture?' I reply to myself, 'No, it is not possible; it is a gigantesque checker-board.' We arrive in Paris. I enter a taxi. Whisht! J'étais chez moi. I had sought that Paris was a great city; it is not. Where are the skyscrapers? They do not exist. In going to America I have lost part of my supreme admiration for my city and my country."

He had learned his English the year before at the Berlitz School in anticipation of a visit to London to attend the congress on sleeping sickness and the Seventh International Congress of Zoology held in Boston in the summer of 1907. As he told me when I met him on the Channel steamer in the spring of that year, "I have studied the English in the School Berlitz, and they tell me I now speak it parfaitement."

Blanchard's student and successor, Dr. E. Brumpt, the author of a famous "Précis de Parasitologie," I first met at Roscoff in 1912. He had a laboratory there and was studying various phases of parasitism. He also is a man of many attractions and a worker of the Blanchard type.

Etienne Roubaud is a younger man who for many years has had his laboratory at the Institut Pasteur. I met him first in Bouvier's laboratory in the Museum of Natural History. He was then studying black flies (Simuliidae). Later he became famous through his writings and investigations, and I have since talked with him in his Pasteur laboratory and have corresponded with him on many subjects connected with medical entomology.

A most interesting experience with the Institut Pasteur occurred many years ago. The brothers Sergent in Algeria were much concerned with a trypanosome disease of camels, carried by Tabanid flies. They wrote to me in Washington, inquiring whether there was in the United States an effective natural enemy of Tabanids. I wrote them at once about the giant wasp known as *Monedula carolina*, and, largely through the help of Wilmon Newell, then in Louisiana, a large nesting ground of the wasp was discovered on the shore of the Gulf of Mexico; pupae were collected; photographs were taken showing the physical conditions of the region and the exposure, and the pupae were sent under refrigeration to the Institut Pasteur at Paris. The Sergents had them conveyed by hand from Paris to Algeria and placed in the sand under conditions as closely resembling those in their original Louisiana habitat as possible. During this operation I visited the Institut and had a formal interview with Roux, the Director, Mesnil, and several of the other experts. I took an interpreter

with me, but found that my somewhat halting French was sufficient, and explained to a deeply interested group the habits of the wasp in the southern United States and as much of its life history as we knew. I think that was my first visit to the Pasteur Institute, and at that time I had the pleasure of meeting Metschnikoff and especially A. Laveran, the discoverer of the causative organism of malaria.

Laveran was at that time a scholarly looking man in his late sixties (I should say), with a full but well cared for white beard. We talked at some length on two or more occasions. On one of them he asked me whether we had some one in Washington who could identify biting Diptera from Indo China. I replied that we had, but said, "Why don't you send them across the Channel to Major Austen, who has recently published an admirable work on the tsetse flies?" Laveran pointed to the book on his shelf, shrugged his shoulders, and changed the subject. I did not quite understand, but imagined that it might have been one way of saying without words something about "La perfide Albion." But I did him an injustice, as I discovered a week later. Then I happened to be in Major Austen's room in the British Museum, and I told him the story. "Oh," he said, "Doctor Laveran! There is a box I had from him more than a year ago, and I have not had time to open it!" Later Laveran sent his French Indies flies to Washington and they were studied by Coquillett.

I have had very interesting talks with Celli, Grassi, Tiraboschi, and Negri in Rome, and knew A. Caccini after he came to the United States, but I will tell my story about these men in later paragraphs. I shall never forget a two hours' journey from the Campagna to Rome over the Appian Way in an ox-cart with Celli, Doctor Vail of Philadelphia, and Doctor Ivantcheff of Bulgaria, a journey which Celli called "our triumphant entry into Rome." This was in 1910, and the Appian Way and the ox-cart did not suggest a modern cement road and a six-cylinder automobile—far from it.

Dr. Erich Martini, of the Hamburg Tropical Disease Laboratory, in 1913 spent part of the summer in Washington studying mosquitoes and other disease-bearing insects. He was a very able and very interesting young man. During the four years of the war he was very busy over there, but since the war has resumed his investigation work, has traveled in southeastern Europe, and has written many good papers. I ran across him one day in 1927 in Major Austen's office at the British Museum. Later I met him and talked with him at the International Congress of Zoology in Budapest in September, 1927; and, fortunately, in August, 1928, he was able to visit the United States again on the occasion of the Fourth International Con-

gress of Entomology. He remarked to me that it would seem as though the Hamburg Institute for Tropical Medical Research had no longer a very good excuse for existence, since Germany had lost all of her tropical possessions.

I did not know Dr. A. Hase, of the Biologische Reichsanstalt in Berlin, until 1927 when I called on him in Berlin and talked over some questions relating to the parasites of injurious insects. I met him later the same year at the Zoological Congress at Budapest. The one big piece of work relating to medical entomology that was done by Doctor Hase was his lengthy and very careful study of the body-louse carried on during the war and after the louse had been proved to be an agent in the carriage of typhus fever and the modified form of typhus known as trench fever. Hase's is the best study of this insect that has been made. He is a well trained man, an enthusiastic worker, fertile in ideas and in the invention of new methods.

In the early part of the century I had the pleasure of meeting Dr. Carlos Finlay of Habana, the man who first conceived the idea that yellow fever is carried by the mosquito then known as *Culex fasciatus* and now known as *Aedes aegypti*. Doctor Finlay spoke little English. He was a man of medium height, well filled figure, a little past middle age, rather slow and deliberative in his manner, and obviously a thinker. The occasion was one of the Pan American Medical Congresses held in Washington. In attendance at this congress also was Dr. Juan Guiteras, a Cuban educated in the States and before the Spanish War a lecturer at the Medical College of the University of Pennsylvania. In 1904, returning by steamer from Mexico, I visited Habana and called on Doctor Guiteras at the Las Animas Hospital. It will be remembered that Doctor Guiteras took up the work with mosquitoes and yellow fever the year after the Army Yellow Fever Commission left Cuba, and carried on a series of experiments confirmatory of the conclusions reached by Reed, Carroll, and Lazear. As it happened, the steamer stopping at Habana ahead of ours in 1904 had come from Tampico, and a case of yellow fever had been found on board. Instead of becoming excited over the finding, Doctor Guiteras had the patient taken from the vessel and carried into the heart of Habana and put in the hospital, realizing that, if protected from mosquitoes, the disease could not be conveyed. He showed me the patient (a man of 40), and showed me his abdomen especially, to prove that there were none of the roseola spots of typhoid, and, since both the room and the bed were screened, we had no fear whatever of contagion—a striking early effect of the mosquito transfer demonstration. It is perhaps worthy of remark that

Guiteras never quite believed Noguchi's announcement years later of his discovery of the causative organism of yellow fever. And it may also be worth mention that when I wrote a review of Guiteras' paper (published in Habana) and submitted it to two scientific journals in the United States, publication was refused.

The Oswaldo Cruz Institute in Rio de Janeiro has a very high reputation in medical circles. It was one of the first administrative organizations to accept and act upon the mosquito discoveries in regard to yellow fever; and the energetic work inspired by this organization rid Rio of yellow fever in an amazingly short time. In 1909 Dr. Oswaldo Cruz himself visited the United States and spent some time in Washington. Dyar, Knab, and I were engaged at that time in the preparation of the Carnegie monograph of mosquitoes, and Cruz, a handsome and delightful man (apparently in his forties), was much impressed by what he saw here. He told me that the principal assistants in the Institute of which he was the head were given traveling fellowships from time to time and that most of them had gone to Europe to study, but that he wanted the next one to come to Washington. So in 1910, Dr. Arturo Neiva came on traveling leave and spent some months here. While he was here he wrote for us an important part of the chapter on malaria in the first volume of "The Mosquitoes of North and Central America and the West Indies." The section headed "The Malarial Organisms" (pages 188-194) was written by him. Although it was not signed by him, its authorship is stated on page 6 of the introduction. In 1912 Dr. A. Goeldi, a Swiss long resident in Brazil, visited us. I met him later in the same year at Oxford. He was author of a large work, published in 1905, on the mosquitoes of Pará. Dr. A. Lutz, very well known for his important work at Sao Paulo and later at Rio de Janeiro and who had long been a correspondent, visited Washington in 1927. In former years Doctor Lutz, in addition to his other important investigations, carried on in Brazil important work with insect-borne diseases and was the first author to take up the subject of the importance of the forest malaria, about which there has since been considerable controversy arising no doubt largely from the rather widely differing habits of the different species of *Anopheles* and due possibly also to the presence in forests of other mammalian hosts of the disease.¹

¹ The Oswaldo Cruz Institute in Rio de Janeiro has continued to do wonderful work in medical entomology. It issues a publication called "Memorias de Instituto Oswaldo Cruz," now in its 23rd volume, and each part is filled with important articles, many of which relate to medical entomology, written by a number of younger investigators of high standing. Dr. A. da Costa Lima,

I shall never forget my very pleasant acquaintance with Dr. Eduardo Liceaga, the President of the Superior Board of Health of Mexico and the personal physician to President Porfirio Diaz. Taking advantage of a trip to Mexico in 1902, I made an effort to study the geographic distribution of the yellow fever mosquito in that Republic. I called on Doctor Liceaga in the City of Mexico, knowing that he had accepted the conclusions of the United States Army Yellow Fever Commission and had instituted antimosquito work throughout at least a part of the Republic. I was cordially received and given letters of introduction. Doctor Liceaga told me with great pride of the organization he had brought about, and mentioned the number of inspectors he had appointed at different points. I was especially interested in the progress of the yellow fever mosquito from Vera Cruz at sea level, through various towns, higher and higher quite to the City of Mexico itself at an elevation of over 8,000 feet. Doctor Liceaga told me especially of his numerous inspectors at Orizaba and Cordoba (towns on the railroad between Vera Cruz and the City of Mexico). My subsequent visits to these towns indicated that, while these inspectors were probably on the pay roll, they were not functioning; although I did meet a physician in Cordoba who told me that he had once seen a lone Indian with a sign on his cap who carried a quart can of kerosene! Later Doctor Liceaga attended the Pan American Medical Congress at Washington at which I had the pleasure of first meeting Finlay and Guiteras.

And by no means must I omit mention of Dr. C. Bonne and his charming wife, Dr. C. Bonne-Wepster, whose great volume on the mosquitoes of Surinam was published in Amsterdam in 1925. They began to correspond with us in 1916, and in 1919 came to Washington and spent many happy weeks with us. They were young, enthusiastic, and did admirable work. Doctor Bonne's high standing in matters of general sanitation gave the work a medical authority that has been lacking in many mosquito papers. From Washington, they went to England and studied in the British Museum, and then returned to

mentioned in our earlier section on Brazil, has done some admirable work under this Institute, and Dr. Cesar Pinto has become known as a worker of great merit. In the current number of the *Memorias* (that for March, 1930) each of these writers has an article.

Just as this book goes to the printer I have received a large, two-volume work by Doctor Pinto entitled (translated) "Arthropod Parasites and Transmitters of Disease." The two volumes are admirably illustrated and cover 845 pages. Unfamiliar as I am with the Portuguese language, it seems to me that these two volumes cover the field more thoroughly and more satisfactorily than any work on the same subject hitherto published.

Surinam for two years, eventually going to Amsterdam where Doctor Bonne took the post of Director of the Laboratory of the Dutch Cancer Research Institute. It is too bad that he has left medical entomology, but I notice that recent papers by Dr. E. W. Walch on mosquito matters relating to the Dutch East Indies have had the advantage of cooperation with Doctor Bonne-Wepster. Doctor Walch himself was in Washington in 1924.

In medical entomology, of course, the Italians have taken a very considerable part. Battista Grassi, a man of broad training, educated in part in Germany, and married to a German wife, and who had written extensively upon many entomological topics, claimed to have antedated Ronald Ross in the discovery that human malaria is carried by *Anopheles*. The bitter controversy that ensued was carried on vehemently until Grassi's death in 1925. Even in 1927, when I called on Ross in England, he could not speak of Grassi without profanity. "Celli," he said, "was a gentleman, but Grassi was a damned pirate." In his earlier writings Ross used to include Celli in his denunciations, and in fact the whole Italian school. In 1910, however, in an expedition with Celli on the Roman campagna, I asked him, rather ironically, whether he had heard recently from his "friend Ross," and he replied that they were now good friends and that he (Celli) had contributed a chapter to Ross' big book, "The Prevention of Malaria," which was published in that year.

The economic development of Italy had been so hampered for so many years by the prevalence of malaria in the southern half of the peninsula that the disease had been more diligently studied there than in any other part of the world. The Italian medical literature on the subject was very great. A number of medical men, including Marchiafava, Celli, Bastianelli, and Bignami, who afterwards became noted in the medico-entomological work, had been assiduously studying malaria and publishing for many years before *Anopheles* was discovered to be the vector, and especially in the interval between the finding of the causative organism of the disease by Laveran in 1880 and the eventful year 1898 when the mosquito relation was discovered by Ross. But Grassi, who was primarily a zoologist, did not really enter the field until 1898 when his "Relations Between Malaria and Certain Insects" was published, but from that time on his papers were frequent, often in collaboration with Bignami and Bastianelli.

I have taken the stand that the award of the Nobel Prize to Ross must have been preceded by so careful an examination of the evidence of priority in the great discovery that the scientific world might well consider the question as settled; but as late as 1923, when calling on

Grassi in Rome, he handed me printed documents which he said conclusively proved that Ross deserves credit only as the discoverer of the vectors of sparrow malaria.

Celli, during the latter part of his life, was fully absorbed in the malaria fight. He was a man of charming personality and of much influence. He was largely responsible for the formation of the anti-malaria association (*La Società per gli Studi della Malaria*) and the publications issued under its auspices,¹ and was instrumental in raising a large sum of money, to which the King himself contributed largely from his private funds, for large-scale work on the Campagna. These facts were recognized, not only by the scientific men of Italy, but were apparently perfectly well known to the peasants on the Campagna.

I visited the Campagna in the summer of 1902, and saw the distressing conditions that existed there before the elaborate "bonification" (as Celli called it) began. Eight years later I visited the region again, this time in Celli's company. The change that had occurred was marvelous. At the first visit the population was scanty; the men and women were most of them obviously chronically malarious; their complexions were yellow and their eyes were dull; the half-clad children were sluggish, many of them with greatly enlarged spleen which produced the appearance known to physicians as "rat-belly"; the agriculture was primitive, and the whole land looked impoverished and half deserted.

On the second visit the contrast was marvelous. The population had increased very greatly; the men were vigorous; the women had rosy cheeks; the children were as active and as healthy as the children of the mountainous regions of Lombardy; capital had evidently gone into the region; great barns and factories were being erected; the land was covered with crops, principally lucerne at that time (my visit was in May, and they were already cutting their third crop). Perhaps what pleased me most was to see the respect and the genuine love that the peasants showed Celli. It was a Sunday, and most of them had just returned from church. The children gathered around Celli in numbers, and he told them stories that evidently were of great interest to them.

This extraordinary result had been brought about, first, by the screening of all habitations on the Campagna, and second, by the virtual quininization of the whole population, on the theory that if the

¹ I contributed two papers to the *Atti* of this Society at Celli's request (see Vols. 11 and 12).

parasitic organisms could be destroyed in the humans there would be no malaria for the *Anopheles* to carry. So the price of quinine was not only greatly reduced by the State, but it was given without price to the indigent, and it was coated with sugared chocolate to make it attractive to small children. Of course the mosquitoes still bit them, but they were for the most part uninfected.

I asked Celli whether it would not be much simpler to fight the mosquito population by the drainage or treatment of breeding places, as we did in America. He replied that they had not the financial means to undertake such measures on a large scale and that the character of the soil was such as to make proper drainage practically impossible. As a matter of fact, of course, both the Romans and the Etruscans, as Celli had shown in his admirable book on malaria, had carried on extensive drainage operations on the Campagna, but these did not go far enough to obliterate the many collections of water in which mosquitoes breed. I noticed that they were breeding freely in the ditches.

Then too, of course, large-scale operations on the Campagna would have been hampered by the prevalence of the absentee ownership of the greater part of the country, the owners not only being absent but apparently for the most part indifferent as to the health of the peasants.

For example, in 1923 I went by automobile with Grassi from Rome to Fiumicino where he had been working for a long time with the help of a very able assistant, Signor Negri, on the problem of malaria reduction. On the property that we visited there were large and apparently useless lakes, the grass-grown margins of which afforded perfect protection to *Anopheles* larvae. Grassi had introduced fish, and talked to me about the possible use of Paris green which had at that time just come into prominence as the result of the work of Roubaud of France and Barber and Hayne of the United States, and also of W. V. King. Of course, I at once asked him why the useless lakes were not drained; and he replied that the absentee owner would not go to the expense.

It was on this trip that Grassi showed me the interesting mating of *Anopheles* at nightfall about certain pigsties on the estate. He had been the first person to observe this mating, in spite of the efforts of many men in many countries for many years.

Grassi's work, especially in this region, had been systematic, and he showed me a mass of records that had accumulated and which undoubtedly contained many facts of value. His especial interest in this region continued until the time of his death. Since 1924, the

International Health Board has stationed a representative (Dr. L. W. Hackett) in Rome, and it is possible that, through this incentive, work may be carried forward on a larger scale.

The Italian Society for the Study of Malaria was founded in July, 1898, by Celli, G. Fortunati and L. Franchetti, and from that time on its activities were extraordinary and the results of its work, as we have already pointed out, were marvelous. The work, as was obviously necessary, covered not only the medical aspects but also the sociological conditions and studies of everything connected with mosquitoes, including particularly control measures. The earliest and almost the most extensive experiments that have been made with fumigants and larvicides (in other words, measures for destroying both adults and the early stages) were made by Italian workers under the auspices of this society. Celli and O. Casagrandi, as early as 1899, published an important paper entitled (translated) "On the Destruction of Mosquitoes—A Contribution to the Study of Culicidal Substances," and in 1900 C. Fermi and S. Lumbao published an important paper entitled (translated) "The Freeing of a City from Mosquitoes"; and the same authors published further important papers. A competent entomologist, E. Ficalbi, who had written about mosquitoes before they were proved to be carriers of malaria, published in 1899 and 1901 important papers upon the Italian Culicids.

Grassi was a man of much personal force and of high distinction in his own country as well as abroad. He was not only an accomplished entomologist known for his investigations in many directions, but also a broad zoologist, and was greatly interested in the medical sciences. That he was made a Senator of the kingdom for life, shows the esteem in which he was held in Italy. I have already referred to his German education and his German wife. In 1910, when I first called on him, we soon found that my Italian was not good enough for close conversation. He could not speak English, and when I tried him in French he asked me whether I understood German, and our conversation was carried on in that language. In appearance he was typically German; he had all of the German mannerisms. He would not talk mosquitoes, although I had called especially for that purpose, but he insisted on talking about the *Phylloxera*s of the oak, a subject upon which he was at work at the time. So the interview was not at all satisfactory. Later during that visit to Rome I met Celli and Tiraboschi, both of whom spoke French fluently; and on subsequent visits to Italy before the war I consulted with Celli rather than with Grassi.

After the war, however, when I visited Italy in 1920, Celli had died, and, meeting Silvestri by appointment in Rome, he insisted that we should look up Grassi, for whom he had great admiration. In fact, he brought Grassi to my hotel at eight o'clock in the morning. To my surprise, I found that Grassi had entirely dropped his Germanisms and had become apparently a most polite, most suave and almost typical Frenchman; his French was fluent, his gestures were French, and it was hard for me to realize that I was talking to an Italian and particularly to the Germanized Italian I had known ten years previously. Evidently this was one of the minor results of the war. I enjoyed my visit with Grassi greatly. And again, in 1923, we had an extremely cordial and very instructive visit. He urged me in 1923 to translate into English one of his manuscripts relating to his important work at Fiumacino and to secure its publication in the United States or in England. But he never sent me the manuscript, and he died in the spring of 1925 before I reached Italy that year.

Grassi was greatly opposed to the project of erecting bat-roosts on the Campagna which had been urged by an Italian General of Engineers who had been in the United States as a liaison officer during the war and, stationed for a while at one of the great concentration camps in Texas, had fallen in with Dr. A. R. Campbell and had become impressed by his bat-roost scheme. This officer tried to push the plan in Italy; and Grassi told me that Mussolini had consulted him concerning the merits of the idea. Grassi said that he told "Il Duce" that bats were more abundant in the most malarious regions of Italy than elsewhere.

A story that I am fond of telling relates to the visit I made with Grassi to Fiumacino in 1923. We were returning to Rome just before dusk in an automobile. We passed a farm where a peasant and his wife were working in the field within hailing distance from the road. Grassi stopped the car and called out, "Hola, Guiseppe." The man dropped his hoe, and instead of coming down to the road turned abruptly and went into the house some distance to the right; but the woman came down to the road and shook hands with Grassi, who turned to me and remarked, "Guiseppe is a great anarchist." Whereupon, I supposed that he had gone into the house to avoid meeting the Senator. Presently, however, the man came out and approached the car, with a bottle of white wine under one arm and three eggs in the other hand. He gave the eggs to the Senator, who took them after a murmured protest, and he offered me a drink of the wine. The Senator, all amiability, remarked, "You know Guiseppe is a great anarchist; and the gentleman here, Guiseppe, is an American." To

which I replied, "Yes, and we have no anarchists in America." "On the contrary," said Guiseppe, "I have a cousin who lives in Chicago, who is a much fiercer anarchist than I am."

As we drove away through the dusk the Senator told me that Guiseppe had been arrested the previous winter for a stabbing affray and had been put in prison. He himself had supported the family while its head was incarcerated, and had used his influence to secure Guiseppe's discharge. This made the peasant eternally grateful, and the gift of the three eggs was an incident of every time the Senator passed the place. He was endeavoring in this way to pay his debt in part.

Evidently Grassi had taken a leaf out of Celli's book and had succeeded in endearing himself to the peasant population of the Campagna in much the same way that Celli had done before the war. I took a photograph of him standing with his arm around a peasant woman. That is a good indication of his change of attitude.

Grassi entirely lost the sight of one eye at some date between 1910 and 1920, and wore very dark spectacles the latter part of his life.

Addendum.—I have referred to Dr. J. H. White and my visit to him when he was closing up the work against the last yellow fever outbreak in New Orleans in 1905. This work of Doctor White and of the Public Health Service has a great historical value since it was the first epidemic of yellow fever to threaten the United States seriously after the demonstration by Reed, Carroll, and Lazear in Cuba. The New Orleans work was such a triumphant success that every detail connected with it should be recorded and preserved. During that summer I was in Europe, and returned to the United States about the first of September. On landing at New York, I heard for the first time of the yellow fever situation in New Orleans and learned of the death there of my old friend, Archbishop Chappelle, whom I had formerly known when he was in charge of Saint Matthews Church in Washington. I finished my work in Washington and started for the Southwest. I had work to do in Texas, and knew that if I entered New Orleans I could not go further into Texas to do the boll weevil work I had to do. So I went by way of St. Louis, and entered New Orleans from Texas. I have found some brief notes that I dictated on my return to Washington, and feel sure that they are of sufficient interest to print.

The City of New Orleans, when I entered it on the night of November 6, 1905, presented its usual appearance—the main streets thronged with people going to the theatre and the cafés full of diners. I was assured that this had been the case for some weeks previously, and that in fact there had been practically no

abnormal interruption of the city's activities during the progress of the epidemic, except such as resulted from the taking off of certain trains from the railroads leaving the city. I had been assured by letters from New Orleans experts as early as September 27 that mosquitoes had virtually been exterminated in the city, yet, after I registered at the St. Charles Hotel and went to the telegraph stand to send a despatch, two mosquitoes buzzed about my ear and were recognized as *Culex pipiens*. On retiring, I found that the room was screened with very perfect window screens, and there was a tight-fitting door-screen as well, outside the ordinary door. The porter stated that the hotel had been fumigated thoroughly in August and that no mosquitoes had been found in bedrooms since. Therefore I did not let down my mosquito bar, but was awakened in the middle of the night by the buzzing and the bites of two or more mosquitoes. Burning Pyrethrum, I stupefied them, and found in the morning that they were *Culex pipiens*.

During the three days in New Orleans I saw but one specimen of *Stegomyia calopus*, and that was in the office of the President of Tulane University on the morning of November 8, about 10 o'clock. I readily recognized it as it flew before my face.

I talked with Dr. H. A. Veazie, who reiterated all of the statements made to me in recent correspondence from him, and on the morning of the 8th I took part in the fumigation of a room containing about 1200 feet of space with the new Culicide, composed of equal parts of carbolic acid and camphor. The fumes are rather agreeable at first, but soon become so strong as to almost stifle one. Dr. J. H. White, in charge of the Public Health and Marine Hospital Service operations in New Orleans from August 12 to date, Dr. Rupert Blue, Doctor Richardson, and six or seven other assistant surgeons in the Service were present. A number of specimens of *Culex pipiens* were flying in the room; there were two boxes, each about a foot long, with gauze sides, containing a half dozen or more mosquitoes each; and a large tube of two inches diameter and possibly a foot and a half in length, the mouth of which was covered with mosquito bar, and which lay on its side on the mantel-piece, and contained several specimens of *Culex pipiens*. About six ounces of the mixture were volatilized by heat, and the room was kept closed, but without any effort to artificially stop cracks, for exactly one hour. On reentering and airing the room, all mosquitoes were found to be dead, and a cockroach was also found dead on the floor, having come up from between the cracks. The vapor is lighter than air, and the mosquitoes in the room, unnoticed on entrance, soon after fumigation sought the lower air strata of the room, gradually descending toward the floor and towards the windows which were on one side of the room only. Sheets of manila paper had been spread before each window, and on these sheets, at the end of the hour, were all of the mosquitoes to be found in the room. No observations were made to determine whether the mosquitoes revived as happens with Pyrethrum fumigation.

I took photographs of the house in which the first case of yellow fever was found in the early summer, and of the first emergency hospital, showing in both cases the method of sealing doors and windows with strips of paper pasted over the cracks; also of St. Philip Street, Chartres Street, and other similar streets in the Italian and French quarters, indicating the character of the residences and shops; also of the street gutters in many of which the water was flowing rather rapidly and in others remained stagnant.

I had several conversations with men who had served through the summer campaign, and made a few notes of facts which they told me, as follows:

In late August or about the first of September, a committee was appointed by Doctor White, consisting of Prof. Rubert Boyce of the Liverpool School of Tropical Medicine, Dr. Quitman Kohnke, the Health Officer of New Orleans, Doctors Currie and Perkins of the Public Health and Marine-Hospital Service, and Dr. H. A. Veazie of New Orleans. This committee conducted numerous experiments, and it is hoped that a report will be published.

Water closet tanks were found to be abundant breeding places of the yellow fever mosquito, and Doctor White suggests that it will be an easy matter to cover these tanks with wire gauze, and that such an arrangement should be enforced.

They have been found to breed in the accumulation of water in the drain-traps of stationary washstands.

The roof-gutters of New Orleans were especially noticed on a number of occasions, where they sagged, to contain large numbers of breeding mosquitoes.

Another interesting place where they were found breeding was in the urns in the cemeteries.

Doctor Richardson stated that at Laredo in 1903 they were found breeding in the lye barrels where ashes were mixed with water for the purpose of making lye.

Doctor Richardson also noticed them in the same year in the holy-water fonts at Laredo. In New Orleans they were also noticed in the holy-water fonts. Here, however, they substituted wet sponges.

It may be stated by the way that a man describing himself as a "practical Catholic" has invented, in Boston, a covered holy-water font for the purpose of preventing the spread of disease.

In New Orleans it is the custom to keep wine cool by placing it in the pools of water accumulating under the water tanks. In these pools the yellow fever mosquito was found to breed extensively.

In some houses in the low quarter of the city water was found to accumulate under the houses in places where it could not well be reached. In these saturated solutions of copper sulphate were thrown with a hose as a spray, and proved reasonably efficacious.

THE PRACTICAL USE OF PREDATORY AND PARASITIC INSECTS

From very early times, writers have pointed out that some insects feed upon others, and of course this was early a matter of common observation among farmers, gardeners, and fruit-growers. Enlightened gardeners, for example, very many years ago realized that the little black and red beetles known as ladybirds were their friends, and in early works on gardening it was advised that these little beetles be placed upon plants, such as rose bushes, that were infested by plant lice.

The study of parasitic and predatory insects is old. Silvestri has pointed out that Aldrovandi in 1602 was the first to notice the exit of the larvae of *Apanteles glomeratus* from the common cabbage caterpillar, and that Vallisnieri (1661-1730) was apparently the first

to discover the real nature of this phenomenon and to realize the existence of true parasitic insects. Réaumur and De Geer, those great students of the life histories of living insects, worked out the biology of a number of parasites; and in the last quarter of the eighteenth century and the first half of the nineteenth many descriptive works on parasites were published.

An early significant suggestion was made by the German writer, G. L. Hartig, who in 1827, in a paper giving instructions for the destruction of "kienraupen," recommended the construction of large rearing cages for parasitized caterpillars in order to rear the parasites in large quantities to be liberated later.

One of the first writers to call especial attention to the great value of parasitic insects to man was Ratzeburg, since he added to his great work on forest insects a large volume on the parasites of forest insects (*Die Ichneumoniden der Forstinsekten*). While he thoroughly understood the part played by parasites in the control of forest insects, he did not believe that this control could be hastened by man.

An early bit of practical work was done by Boisgiraud of France, who in 1840 collected numbers of the Carabid beetle, *Calosoma sycophanta*, and placed them upon poplars along a road in Poitiers, where they destroyed the caterpillars of the gipsy moth. The same observer destroyed earwigs in his own garden by placing with them a predatory rove beetle (*Staphylinus olens*).

The work of Rondani in Italy, a systematic writer on parasitic insects, was important, since it contained tables giving the host relations of different species. His work was published between 1840 and 1860. Silvestri has called attention to the fact that, in the dispute which sprang up in Italy about 1868 as to the usefulness of insectivorous birds to agriculture, Dr. T. Bellenghi was referring to Rondani when he spoke in 1872 the prophetic words "Entomological parasitism has a future, and in it more than in anything else Italian agriculture must put its faith."

Several authors between 1872 and 1882 made practical suggestions as to several ways of permitting the escape of parasitic insects before the destruction of their hosts, notably Riley in the case of the rascal leaf-crumpler (*Mineola indigenella*); the French writer, F. Decaux, in regard to the parasites of the apple bud weevil; Comstock with the parasites of the imported cabbage worm; Riley with the bag-worm, and later Berlese and Silvestri in Italy and Marchal in France.

Suggestions were made regarding the transfer of parasites from one part of a given country to another part of the same country, by LeBaron in 1872, Decaux in the same year, by Riley in 1870, and by

the writer in 1880; and an important experiment of this kind was carried on by Webster in 1906 with parasites of the Hessian fly in the United States.

The transfer of beneficial insects from one country to another, however, while suggested by Asa Fitch with regard to the European parasites of the wheat midge as early as 1854, was not acted upon successfully with other parasites until much later. In 1873 Planchon, with the help of Riley, introduced into France an American predatory mite (*Tyroglyphus phylloxerae*) which feeds upon the grapevine *Phylloxera* in the United States. The mite is said to have become established in France, but has accomplished no appreciable results in the way of checking the famous grapevine pest.

In 1874 attempts were made to send certain parasites of plant-lice from England to New Zealand, but without results of value, although *Coccinella undecimpunctata* is said to have become established.

In 1883 Riley imported the Braconid, *Apanteles glomeratus*, into the United States from Europe where it is an important enemy of the imported cabbage worm. This species in course of time established itself in the United States and has proved to be a valuable help to truck growers.

These experiments, however, were completely overshadowed by the remarkable success of the importation of *Novius cardinalis*, a Coccinellid beetle, or ladybird, from Australia into California in 1889. The orange and lemon groves of California had for some years been threatened with extinction by the injurious work of the fluted or cottony cushion scale (*Icerya purchasi*). This scale was known to have been imported accidentally from Australia or from New Zealand. Entomologists and fruit-growers had become disheartened by the expense of treating the trees with competent washes. Riley had found that, although the *Icerya* occurred in Australia, it was not injurious over there; whereas in New Zealand, where it also occurred, it was abundant and injurious. He concluded that Australia was the original home of the species and that it was held in check there by some parasite or natural enemy. In 1887 he received specimens of an Australian parasite—a Dipterous insect which was described by Williston as *Lestophonus iceryae*. Riley then wished at once to go to Australia and to secure abundant material of this Dipterous parasite and bring it to California. Congress, however, had recently added a provision to the bill making appropriations to the Department of Agriculture which forbids foreign travel on the part of employees of the Department. It is no secret that this provision was aimed at Professor Riley in order to stop his journeys to Europe at Govern-

ment expense. Riley, however, was not to be deterred by this fact, and he puzzled over the situation until he found a solution. It chanced that in the following year an international exposition was to be held at Melbourne, and Congress had appropriated money to the State Department to finance representation by the United States. Hon. Frank McCoppin, formerly postmaster of San Francisco, had been appointed head of the American commission to the exposition, and Riley interviewed the State Department and requested that one of his assistants be sent to Australia, at the expense of the exposition fund, for the purpose of securing the parasites. McCoppin, being a Californian, favored the scheme, but made the proviso that at the same time Riley should send another assistant to make a report on the agricultural features of the exposition. So Albert Koebele was sent to get the parasites, and F. M. Webster to make the report on agriculture.

The results of Koebele's work are now known everywhere. The story has become a classic in applied entomology and horticulture. He sent over the *Lestophonus*, which, however, did not prove a success; but he also found the famous little ladybird *Novius cardinalis* (then called *Vedalia cardinalis*), forwarded colonies to Los Angeles, where another Department of Agriculture assistant, D. W. Coquillett, had made preparations to receive and colonize the natural enemies of the scale. Between November 30, 1889, and January 24, 1890, Coquillett had received 139 of the little beetles in three sendings—28 on November 30, 44 on December 29, and 57 on January 24. As early as April 12, Coquillett had begun sending out colonies, so rapidly did the species breed. By June 12, 11,000 specimens had been sent out to 208 orchardists, and by the end of the year the scale insect was practically no longer a factor to be considered in the cultivation of oranges and lemons in California. The following season it practically disappeared, and since that time it has never been a factor in California horticulture. Once in a while it begins to increase in numbers at some point, but the Australian ladybirds are always kept breeding by the State Board of Horticulture, and such outbreaks are reduced speedily.

The effect of this experiment on the horticultural world was extraordinary. It aroused great hope, especially in California, that the keynote to insect warfare had been sounded, and many of the leading men in the State were so enthusiastic that they advocated the instant stopping of all other kinds of warfare against insects. As we have elsewhere shown, the progress of economic entomology in Cali-

ifornia was retarded for many years by the fact that so many people in power and so many growers dropped their faith in any other method.

Novius cardinalis proved to be a very extraordinary insect in many ways. It was taken from California to New Zealand, and again, to Portugal, and South Africa, and Egypt, and the Hawaiian Islands, and Italy, and Syria, France, Uruguay, all points into which the fluted scale had been established; and everywhere the introduction met the same speedy and perfect success. It is interesting to note, however, that in one case, where it was sent with a supply of the fluted scales for food to Florida in the hope that it would feed upon other scale insects, the only effect of the introduction was to establish the fluted scales, which had been sent for food, in this new locality. This, however, had only a temporary effect, but it well illustrates the danger of careless introduction work.

It is unfortunate that Riley did not get the credit he deserves in connection with this great experiment. The Californian, Mr. McCoppin, insisted until his death that the glory belonged to him and to Koebele, and not to Riley. Many others have given the whole credit to Koebele, and in fact international work with parasites and predators has been called, in certain German publications, the Koebele method. The truth of the matter is, however, that the idea was conceived by Riley; that by logical reasoning and expert correspondence he identified Australia as the country to which to send for natural enemies; that by his ingenuity and insistence he was able to exchange Webster's services as agricultural reporter for the trip at Government expense by Koebele; and he was responsible for the selection of Koebele, a wonderful field man, for the important work he did so well.

California went wild over this success. Koebele was sent again to Australia, and also to New Zealand and the Fiji Islands, still holding his post as an employee of the United States Department of Agriculture, but at the expense of the California State Board of Horticulture. In 1893 he resigned from the Federal Department and was employed by the State Board of Horticulture of California for still another trip to Australia and other Pacific islands. He sent home a large number of beneficial insects, nearly all of them, however, Coccinellids. Several of these species were established in California and are still living in different parts of the State, but the overwhelming success of the importation of *Novius cardinalis* was not repeated, except possibly in the case of *Cryptolacmus montroussieri* Muls., an insect which feeds upon mealy-bugs. This latter insect has proved

very successful in California for many years, and has been sent from that State to many different countries, in each case proving to be a great aid in mealy-bug control. Koebele left California in the early nineties, and was employed by the newly established Hawaiian Republic for which he traveled extensively in Pacific and Oriental regions and found a number of valuable insects which were introduced with good effect into the islands.

When Koebele left California the authorities of that State did not propose by any means to stop the work that he had begun for them. They must have realized that he was a very unusual observer and a remarkable collector and at the same time an entomologist of very broad knowledge. These considerations, however, did not seem to influence them in the appointment of his successor. Apparently they thought that the work could be done with equal effect by any man of sufficient energy and perseverance. Therefore they started George Compere, a man of considerable orchard experience but who was a virtual tyro in entomology, on various trips to various parts of the world in search of parasites of various insects. I have not a word to say against Compere's honesty of purpose, skill as a traveler, extraordinary energy and great perseverance, but his lack of entomological knowledge led him into many mistakes and demonstrated that work of this kind is extremely complicated and must be undertaken with the greatest care and only by the most skilled men. It is only by the barest chance that California escaped the introduction and establishment of more than one injurious insect and more than one secondary parasite through the wholesale sending of forms as carried on by Compere for some years. The State built an insectary at Sacramento, but for years no thoroughly competent entomologist was placed in charge of it. Surely one very injurious hyperparasite was liberated during this period, and probably more than one. Several times he sent home forms as parasites which proved not to be parasites at all. Once he sent, with enthusiastic commendations, a parasite which he said came from the black scale but which later proved to be a parasite of a predatory Lepidopterous larva living under masses of the scale. Later for a time he was employed jointly by the colony of West Australia and the State of California, and it was some years before his influence in such matters dwindled. He then became an inspector at the port of San Francisco under the quarantine department of the State Department of Agriculture and did excellent work in that capacity. It is unfortunate that in his earlier work his energy and devotion were not based upon a broad and accurate knowledge of the creatures with which he was working. The extent and char-

acter of his early travelings justify Paul Marchal's expression "L'incroyable Cdysey de Monsieur Compere."

Since those days, by degrees, the study of the natural enemies of imported insect pests has become a part of the program of every project based on imported pests in the United States as well as in many other countries. Work of this sort has been carried on since 1905, and on a very large scale, with the European and Japanese natural enemies of the gipsy moth and the brown-tail moth, and with a very considerable degree of success. Many species have been acclimatized in America and have undoubtedly been of great assistance in the control of these species and in the prevention of their spread. Similar efforts, also on a large scale, have been made in connection with the work against the Japanese beetle and the European corn borer. Laboratories have been established in Japan for the work against the first-named species, and in the south of France for the work against the corn borer. Many species have been carefully studied and introduced, and several of them have become established, with results as yet not carefully estimated but which cannot fail to be of benefit.

Some rather extraordinary things have been done with other parasites. Hawaii had made great success of this kind of work, and it is safe to say that very great losses have been saved to the sugar cane industry over there by the importation of parasites of the sugar cane leaf-hopper and of one of the cane borers. Similar successes have been had with other insects in Hawaii. There, however, conditions are particularly favorable. There is an equable, subtropical climate, without any great change of seasons. Introduced forms, both of animals and plants, take hold readily and flourish. Most of the pests have been introduced, and when their natural enemies are also introduced the latter flourish to a remarkable degree at the expense of the former.

One of the most successful experiments of this nature, that may be said to have proved its value completely, was the introduction of a minute parasite, *Prospaltella berlesei* Howard, from the United States into Italy to destroy a noxious scale insect of the mulberry (*Diaspis pentagona* Targ.) which threatened the extinction of the white mulberry in Italy and therefore the extinction of silk culture in that country. From a single sending from Washington, Berlese and his assistants bred the original stock of these parasites which have since 1906 virtually accomplished the control of the scale.

Aphelinus mali, another little Hymenopterous parasite, less than a millimeter in length, which lays its eggs upon the aboveground

forms of the woolly root-louse of the apple, has been taken from the United States to France and distributed, either from the United States or from France, to England, Switzerland, Germany, Italy, New Zealand, Australia, South Africa, Uruguay, Argentina, and Chile, with somewhat varying results but on the whole admirable ones. In New Zealand and Australia especially, this species has spread rapidly and has controlled the injurious forms.

And there are many other instances. A great mass of work has been done. Very many species have been tried out. Many importations have been unsuccessful. Some of these have been unsuccessful because of faulty methods of one kind or another. Others again have been successful in spite of what we are coming to know are faulty methods. The whole subject of insect parasitism is being studied by a rapidly increasing number of well trained men. The early work of Fiske in his especial studies of the parasitism of the gipsy moth and the brown-tail moth, as displayed in Bulletin No. 91, new series, of the Bureau of Entomology, have been followed by the close and philosophical study of the phenomena of insect parasitism especially as relates to the parasites of the European corn borer by W. R. Thompson; and some of the men in Hawaii, notably Pemberton and Willard, have developed points of much practical importance. We are finding that the question is one which is infinitely more complicated than we had supposed 20 years ago, and that the early views of the Californians, based upon a single and very exceptional instance, were in fact nothing less than absurd. Especial studies must be made in every individual case, and these studies must be made by highly trained experts. There are always many dangers to be studied and avoided; and, while certain general principles hold, there are many facts connected with each individual species which must be understood. I do not waver in my unfailing belief in the basic value of the principle of biological control, but my outlook becomes more or less confused when I consider the complications. There can be no doubt, however, that the subject deserves the most careful study in every case, and there can be no doubt that many times great practical results may be reached by the importation of the parasites of accidentally imported injurious forms.

In 1925 an important paper was published in Paris with the title "L'Importation Pour les Besoins de l'Agriculture d'Insectes Entomophages Étrangers." It was written by Dr. B. Trouvelot, of the Station entomologique de Paris, and was published in the *Revue de Zoologie agricole et appliquée*, Nos. 6 and 7, 1925. In this paper the author has listed chronologically international efforts in parasite introduction,

and has given comments relative to their success or failure. I rather wish that it were possible here to follow out this plan to date. Trouvelot's list was by no means complete for the period it covered, and since the date of its publication many new efforts have been made by many nations, and, as in the case of *Aphelinus mali*, the same parasite has been taken with success to many different countries and to many distinct life zones. Further, experience has shown that reports of success are frequently premature, while reports of failure are *very often* premature; and there are recorded already cases where parasites have recovered 20 and even 23 or 24 years after introduction, all hope of success having in the meanwhile been abandoned.

Many articles discussing various aspects of natural control have been published in recent years. Some of them look at the subject from an ecological standpoint, as in fact is very necessary, while W. R. Thompson actually goes into the mathematics of the subject. The simple, broad idea that the writer had when he began to bring parasites of the gipsy moth from Europe to America, that to reproduce in this country so far as possible the parasite complex that exists in Europe would be the desirable thing to do, and that to do it was simply to bring over in number the parasitized stages of the host insect, is now referred to condescendingly by recent workers as "the old method," but it is still being followed in the main in much of the big importation work that is going on.

I think it will be well to publish here the chronological list as printed by Trouvelot. It is, put into English, as follows:

TROUVELOT'S LIST (1925)

- 1873 Introduction into France of *Tyroglyphus phylloxerae* Riley. American parasite of Phylloxera.—No appreciable results.
- 1874 Introduction of *Coccinella 11-punctata* from England into New Zealand.—Acclimatized, but no results.
- 1883 Introduction of *Apanteles glomeratus* from Europe to America to fight cabbage worm.—Good result.
- 1889 Importation of *Noctius* into California from Australia.—Splendid result. Afterwards constantly successful in Italy, Portugal, Florida, Cape Colony, Hawaii, Egypt, France, etc.
- 1891 Importation into America of European parasites of the Hessian fly.—One species recovered.
- 1892 Attempted introduction to California of *Thalpochares cocciphaga*, an Australian Lepidopterous parasite of wax scales.—No result.
- 1892 to 1902 Trials of the same nature with the European *Erastria scitula*.—No result.
- 1892 Attempted introduction into the United States of a Clerid (*Thanasimus formicarius*), European predator on the larvae of bark-beetles.—The species not recovered.

- 1893 Introduction into California of *Rhizobius ventralis* from Australia to kill black scale.—Good result.
- 1893 Introduction from Australia into California of *Cryptolacmus montrou-sieri* for mealy-bugs.—Work repeated with equal success in France.
- 1896 Introduction from Ceylon to Hawaii of *Coccinella repanda* against sugar cane aphids; and of *Chalcis obscurata* from China against *Omiodes blackbourni*, a Lepidopteron attacking bananas and palms.
- 1899 Sending from Australia to Hawaii of numerous parasites against wax scales and sugar cane leaf-hopper.—Several of them were very important and established themselves.
- 1900 Importation into California from Cape of Good Hope of *Scutellista cyanea* against the wax scale.—Appeared to be lost, but was found after 20 years.
- 1902 Introduction from China into the United States of *Chilocorus* against the San Jose scale.—Good success.
- 1904 Importation from Spain into California of *Calliephialtes messor*, parasite of codling moth.—Successful but of doubtful value.
- 1905 Importation into Italy of different Coccinellids and Hymenopterous parasites of the white scale of the mulberry from North America, South Africa and Japan.—Good result.
- 1905 Attempted acclimatization in America of European parasites, especially *Tetrastichus xanthomelaenae*, of the elm beetle.—Species has not been recovered.
- 1907 Importation into Australia of South American parasites of the fruit-fly.—No success.
- 1907 Attempted introduction into South Africa of American parasites of ticks.
- 1908 Attempted introduction into Algeria of a burrowing wasp (*Monedula*) capturing gadflies.
- 1910 Attempted acclimatization in Dutch East Indies of American parasites of different tobacco caterpillars.
- 1911 Search in India for various parasites of Alecyrodes and their attempted introduction into Florida.
- 1913 Attempted introduction into France of American parasites of *Polychrosis*.

WORK STILL IN PROCESS

- Importation into United States of the European and Asiatic parasites of the brown-tail moth.
- Introduction into Hawaii of parasites of fruit-flies.
- Importation into Europe of the North African and East African parasites of the olive fly.
- Acclimatization in different regions of *Aphelinus mali*.
- Introduction into America of the European parasites of the alfalfa weevil.
- Introduction into America of the European parasites of the European corn borer.
- Utilization in France of the California parasites of the potato tuber-moth.
- Search in Europe for the parasites of the pear leaf midge for sending to New Zealand.
- Importation into Italy of the East African parasites of *Chrysomphalus minor*.
- Search in Japan, Korea, China, India, and Russia for the parasites of the Japanese beetle, for the United States.

Importation into the United States of Mexican parasites of the bean weevil.

Introduction into Mauritius of the Madagascar parasites of *Oryctes* living on sugar cane.

Introduction into France of *Doryphorophaga*, a fly parasite of the Colorado potato beetle.

Doctor Trouvelot, in the preparation of this list, had to examine many publications. He was fortunate, however, in having three papers that gave rather full summaries of work that had been done previously. Paul Marchal, for example, had published in the *Annals of the National Agronomical Institute*, Series 2, Volume 6, pp. 281 to 354 (1907), a very full paper entitled (translated) "Utilization of Auxiliary Entomophagous Insects in the Struggle Against Insects Injurious to Agriculture." This large paper I translated in full, and the English text was published in the *Popular Science Monthly*, Volume 72, pp. 352 to 370 and 406 to 419, April and May, 1908.

Another very full account that goes into much detail concerning the work that had been done on introduced parasites down to that time was published in the *Bulletin of the Italian Agricultural Society*, Volume 14, No. 8, April 30, 1909, by Prof. F. Silvestri. It was entitled "Remarks on the Present Condition of Agricultural Entomology in the United States of North America and What Italian Agriculture Can Learn." This report, covering 65 closely printed pages, was done in large part into English in Hawaii and published in the August, 1909, number of the *Hawaiian Forester and Agriculturist*, pp. 287 to 336.

In the *Yearbook of the United States Department of Agriculture* for 1916 I published, on pages 273-288, an illustrated article entitled "The Practical Use of Insect Enemies of Injurious Insects," in which I mentioned a number of experiments that had been carried out subsequent to the publication of the admirable summaries by Marchal and by Berlese.

Many articles have been written in many languages on the general subject. It has, in fact, attracted universal attention.

In the following pages I will consider this question of parasite importation under the different countries (arranged alphabetically) and, under each country, chronologically. Many things will necessarily be omitted, which is a pity, since every attempt, even the blatantly unsuccessful ones, should be listed if a thoroughly competent study of the whole subject is to be made. There are undoubtedly many of which there exists no printed record. It would be interesting if we could secure data concerning as many as possible of George Compere's

importations into California, and also concerning his importations into Western Australia. It may be mentioned here that after Compere's announced finding of fruit-fly parasites in Brazil and their importation into Australia, Lounsbury and Fuller, from South Africa, went to Brazil and failed to substantiate the published statements made by Compere. There are also other matters which cannot be mentioned in such a consideration as we shall be able to give the matter, but what follows is offered as a necessarily incomplete historical effort.

ALGERIA

The introduction of a predatory wasp into Algeria in 1908 is mentioned in Doctor Trouvelot's list; but something more should be said about it, as it is really of a unique character. There was, and perhaps still is, a disease of the dromedary camels in Algeria, then the principal beasts of burden in that country. The Pasteur Institute of Paris, having a branch at Algiers, investigated the disease and found it to be caused by a Spirochaete. The brothers Sergent, in charge of the investigation, discovered that this Spirochaete was carried by certain gadflies. They further discovered that these gadflies were killed off by certain robber flies but that the robber flies were not active at the exact period when the gadflies were most abundant. At the advice of Dr. E. Roux, Director of the Pasteur Institute at Paris, Dr. E. Sergent consulted the Federal Bureau of Entomology at Washington. At Washington we immediately recalled the fact that in the southern United States there is a large wasp known down there to the people as "the horse guard," well known to be an active destroyer of gadflies. Dr. Wilmon Newell, then stationed at Shreveport, Louisiana, as an official of that State, was consulted. He found a place on the shore of the Gulf not far from New Orleans where this wasp (*Monedula carolina*) was nesting. Their burrows were dug up, and in the pupa stage they were placed in especially prepared buckets and put in charge of one of the stewards in the cold room of a steamer going directly from New Orleans to Havre. There they were met by agents of the Pasteur Institute and were carried directly to Algeria. Exact descriptions of the topography of the American breeding-places, together with photographs showing exposure and so on, were sent with the specimens. A similar locality was selected on the south coast of the Mediterranean, and subsequently some of the wasps issued; but, so far as has been reported, the species has never again been seen over there. The length of the journey from Havre to Algiers (almost 15 days actually) was probably too great for the survival of the majority

of the specimens. The ice was entirely melted on arrival at Marseilles, and the cocoons had become moist.

The experiment has never been repeated, but it seems quite possible that it might be successfully carried out at any time.

ANTIGUA

A paper by A. Gallwey reported in 1929 that attempts had been made to control the moth borer of sugar cane in Antigua by Bracnids, *Ipobracon* and *Microdus*, introduced from British Guiana, and begun in 1927. This material was probably originally found in British Guiana by Harold E. Box. The results are reported to have been inconclusive.

ARGENTINA

Aside from the successful introduction and acclimatization of *Aphelinus mali*, the only other experiment of record was the introduction from Italy of *Prospaltella berlesci* How. in 1913. It was reported in 1916 that 4,650 fruit-growers had applied for twigs carrying parasitized scales and had received in all 530,000 twigs, making a total of 3,000,000 twigs distributed during three years. At the time of writing it was considered that the parasite was sufficiently well established, and the distribution of parasitized twigs was about to be discontinued.

AUSTRALIA

Largely through Mr. George Compere while acting as Entomologist for Western Australia, many parasites were introduced from California and from Hawaii, most of them parasites of scale insects; and Doctor Tillyard sent to Australia colonies of *Aphelinus mali*, descendants of those he had secured for New Zealand from the United States. Several other importations have been urged, and at least one of them was tried without success. The sheep blow-fly, a great pest in Australia, was studied carefully by several writers in Australia, and seven of its native parasites were also carefully studied. These parasites, however, did not control the pest, and during April of 1925, according to W. B. Gurney and A. R. Woodhull (Bulletin 27, Department of Agriculture, New South Wales, May, 1926), a few parasites of the European blow-fly were reared from pupae sent from England. These parasites were *Alysia manducator*, and they did not attack the Australian maggots although they were tried with several species. I understand that later experiments have been made to introduce European enemies of blow-flies, and I remember with

great distinctness encountering a vile odor in the garden of the Parasite Laboratory at Farnham Royal in 1927 and upon inquiry being told that it came from the dead body of a cat on which were feeding maggots from which it was expected to rear parasites for shipment to Australia.

BRAZIL

Novius cardinalis was imported into Sao Paulo, Brazil, from South Africa and later from Italy and Uruguay. According to Dr. C. H. T. Townsend, in 1921 it was firmly established and the *Icerya* was in the way of being exterminated.

When *Prospaltella berlesci* was introduced into Uruguay in 1920, it was sent to Argentina the following year, and arrangements were also made to introduce it into Brazil; and in 1921 notice was given in Sao Paulo to the effect that the parasite was now obtainable by orchard growers suffering from *Diaspis pentagona* on their trees and that supplies could be obtained from the phytopathological service of the State.

CANADA

In 1913 J. D. Tothill, having been sent by the Canadian Government to study the parasites of the brown-tail moth being reared for the United States in Massachusetts, took puparia of *Compsilura concinnata* from Massachusetts to two localities in New Brunswick, and also other parasites and the predacious beetle, *Calosoma sycophanta*.

Not long after the United States Bureau of Entomology began to import parasites of the European corn borer, a parasite laboratory was established in lower Ontario; material was sent on from the United States parasite laboratories, and large numbers of several species of Ichneumonids and Tachinids of European origin were liberated in Ontario fields.

As a rule Canada has been content to share with the United States parasites imported by the latter that affect introduced pests common to both countries. The United States, with more means, with more trained assistants, has been heretofore in better position to charge itself with the somewhat dangerous work. Of late, however, Canada has been training very good men, has more means than formerly and has become competent to do work of this kind, although a beautiful spirit of cooperation still exists in such work between the two countries.

There was, however, one very interesting importation made by Canadian experts as early as 1911. Dr. C. Gordon Hewitt had found in England (in 1908) an important parasite (*Mesolaius tenthredi-*

nidis) of the larch sawfly (*Nematus erichsonii*). Hewitt came to Canada in September, 1909, to succeed the late James Fletcher, and finding that the larch sawfly was very injurious in Canada, he made arrangements to import parasitized cocoons from the English lake district into Canada. Cocoons were brought over in the spring of 1911 and distributed in several localities in Quebec and Ontario, a small lot being also sent to the State Entomologist of Michigan. In 1912, Doctor Hewitt visiting England found a locality where the parasites were very abundant, and he had other supposedly parasitized cocoons brought over and distributed in Manitoba in two tamarack swamps in a forest reserve. In 1916 it transpired that the parasite had become satisfactorily established, and later reports by Mr. Norman Criddle of Manitoba have indicated that the parasite has been a very great success.

CEYLON

In 1918 there was a serious outbreak of *Icerya purchasi* on *Acacia* in the Dimbula district in Ceylon. *Novius cardinalis* was received from South Africa, but on account of the length of the journey the beetles and larvae died, and the outbreak of the scale was suppressed by mechanical means. In 1920 J. C. Hutson reported that the *Novius*, after the failure of four consignments from South Africa, finally in 1920 took hold and bred rapidly with great success against the *Icerya*.

CHILE

Prospaltella berlesei was imported direct from the United States into Chile in 1914 and was as successful there against *Diaspis lanata* as it was in other South American countries.

The Eucalyptus weevil (*Gonipterus*) was accidentally introduced into Chile at an unknown date. In 1928, C. A. Marelli, in an article published in the *Revista Chilena Historia Natural*, announced the importation of a Mymarid egg-parasite from South Africa to which place it had been introduced from Australia.

DUTCH EAST INDIES

We have elsewhere described the visit of L. P. de Bussy to the United States in 1911. His principal object in coming over was to secure parasites of *Chloridea* (*Heliothis*) *obsoleta* which was doing great damage to the tobacco plantations in Sumatra. In 1912 the first report on the work of the parasite was printed. Parasites were sent over in the eggs of the host insect in cold storage, and only a very small percentage failed to hatch. At the time of the first report in 1912

the parasite had passed through 16 generations and had multiplied in the open. During the same year a report was published by W. Roepke stating that the first attempts to get parasitized eggs from America in good condition failed, but that an intermediate breeding station was established in Holland. Moreover, the first lot from America gave out only male parasites; later ones, however, produced females that were sent on to Sumatra.

For some years I noticed no reports on the later results of this introduction. In 1918, however, J. E. A. den Doop published an article in the records of the Experiment Station at Deli, Sumatra, in which he stated that he had been investigating the subject under field conditions since 1916. He found the parasites existing in numbers and attacking the eggs of a large number of injurious moths. He concluded that *T. minutum* could be used against *Heliothis obsoleta* and also perhaps against *Plusia*, but not against *Prodenia*, *Phthorimaea*, and *Botys*.

In 1924, S. Leefmans reported the importation of parasites of the coffee berry borer from Uganda into the Dutch East Indies. One of these parasites was believed to be a Bethyloid, *Prorops nasuta*.

The question of native parasites had been studied years before by L. Zehntner.

EGYPT

Novius cardinalis was introduced into Egypt from the United States in 1892. It was sent to Alexandria to feed on *Icerya aegyptiacum*.

Of recent years, *Microbracon kirkpatricki* was introduced from Kenya, where it is an efficient parasite of the pink bollworm, into Egypt, according to A. Alfieri writing in 1929.

FII

In 1913, F. P. Jepson, then Government Entomologist of Fiji, transported 5,000 Histerid beetles (*Plaesius javanus*) to Fiji from Java, as it was an important enemy of the banana weevil (*Cosmopolites sorditus*). Twelve hundred perished on the way, and 3,500 were distributed in lots of 500 on seven different plantations. I have not learned the subsequent history of this introduction.

In 1913, the Tachinid fly, *Ceromasia sphenophori*, that had done excellent work against the sugar cane borer in Hawaii, was introduced into Fiji by J. F. Illingworth. A thousand parasitized grubs were carried over. It was found that only a strong colony could withstand the losses caused in the field by predatory enemies, notably ants and spiders.

In 1926, J. D. Tothill reported concerning a Clerid beetle introduced into Fiji for the destruction of the *Levuana* caterpillar, and in this report especially spoke of a Tachinid, *Ptychomyia remota*, of which 300 adults were introduced in 1925 from Malaya. This report states that 32,621 flies had been reared and liberated in 38 colonies, and that the parasite was then spreading so rapidly that no further liberations appeared to be necessary. A rate of parasitism ranging from 75 to 90 per cent had been noted. This experiment turned out to be one of the most dramatically successful ones in the history of the work.

In fact the Fiji entomologists have paid great attention to the possibilities of parasite introduction. This is quite proper, from the fact that the greatest successes in this work have been gained on islands. Aside from the introductions mentioned, Mr. H. W. Simmonds brought in two species of Aphelinines from Tahiti in 1919 with moderate success. Mr. T. H. C. Taylor introduced a Clerid beetle for the *Levuana* caterpillar, which, however, did not prove successful. And there have been other introductions; nothing, however, meeting with a success comparable to that of the Tachinid for the *Levuana* caterpillar, which was so striking that it deserves further mention.

The so-called *Levuana* caterpillar is the larva of a Zygaenid moth (*Levuana iridescens*). It made its appearance in Fiji possibly as early as 1871, but it did not attract much attention until about the close of the World War. It fed upon the foliage of the cocoa palm and to some extent upon other palms. It was feared that it would spread over all the Pacific islands, destroying the coconut and bringing calamity to the natives.

In the Malay States a somewhat related caterpillar (*Artana catoxantha* Hampson) also fed on coconuts. The entomologists in Malaya reared a Tachinid parasite from this caterpillar which was described by Doctor Aldrich of the United States National Museum in 1925 as *Ptychomyia remota*. On the chance that this parasite would attack the *Levuana* caterpillar, it was imported into Fiji as mentioned in a previous paragraph. In 1928 Prof. T. D. A. Cockerell, of Colorado, visited Fiji, and in an article published in the journal *Science* for December 7, 1928, he speaks of this parasite and its introduction, in the following words:

Results were apparent in about six months. The fly spread with great rapidity and in a short time the *Levuana* pest was practically a thing of the past. When I was in Suva I was shown the coconut palms with fresh green foliage ready to bear abundant fruit. I could only imagine from descriptions what they

looked like not long ago. . . . As an example of successful biological control through cooperation among scientific men, the case of Levuana could hardly be excelled.

FORMOSA

In 1925, M. Ishida, Entomologist of the Sugar Experiment Station at Formosa, worked on parasites of the woolly sugar cane aphid (*Oregma lanigera*). This scale insect is an important pest to cane in the Orient, especially in French Indo-China, and also in Formosa. Search for its natural enemies resulted in the importation of a Coccinellid, *Coclophora biplagiata*, from Formosa to Java, and of a Chalcid parasite, *Encarsia flavoscutellum* from Java into Formosa. Two Coccinellids were also taken from Java to Formosa. It seems that two attempts were made to take over the *Encarsia*, but failed, owing to the short life of the adults. A third was reported in 1926 by P. van Harreveld as being in course.

Obviously the journey was too long, and a relay station was necessary. Ishida, writing again in March, 1929, in the Report of the Government Research Institute of Formosa, states that Hongkong was used as a relay station, and parasites were reared there from material received from Java and then relayed to Formosa and successfully liberated in large numbers.

FRANCE

Practically all of the French attempts at introduction are mentioned in Doctor Trouvelot's list. In 1910 *Icerya* spread from Italy into France, and the introduction of seven specimens of *Novius* from Portici to Cap Ferrat in the South of France rapidly resulted in the wiping out of the infestation. Wherever *Icerya* appeared thereafter in the South of France the Australian ladybird was used with equal effect.

The importations of *Habrobracon johannseni* from California to help destroy the potato tuber-moth were first agitated in 1919, and these attempts have met with apparent success from time to time. For example, Trouvelot reported in 1924 that the success was considerable. But the parasite has apparently since died out, and further importations are desirable.

The introductions of *Cryptolaemus montrouzieri* against mealybugs have been successful; but the 1921 importation of *Hippodamia convergens*, also from the United States, was apparently not successful.

The visit of Doctor Trouvelot to the United States in 1928 resulted in further attempts to introduce and establish *Doryphorophaga*, an

enemy of the Colorado potato beetle which appeared in western France after the World War.

A long paper has just been published by Doctor Marchal giving a full account of the history of the *Aphelinus mali* introductions and giving an account of the insect's biology in France and its status as an enemy of the woolly root-louse. It seems now to be a permanent resident in France.

GREECE

Novius cardinalis was introduced into Greece to prey upon *Icerya purchasi*, and in March of 1928 A. Ayoutantis reported that it was then established in two centers near Athens.

GUAM

Numerous attempts have been made to bring in parasites of injurious insects into Guam by S. R. Vandenberg. Three of these introductions were very successful, namely *Novius cardinalis* for the cottony cushion scale, *Cryptolaemus montrousieri* for mealy-bugs, and the Tachinid, *Ceromasia sphenophori*, for the sugar cane beetle borer. An attempt was made to establish the Coccinellid, *Lindorus lophanthæ*, but without success; and attempts made to establish *Comperiella bifasciata* from California on the red scale were also unsuccessful.

HAWAII

Some of the most extraordinarily successful work that has been done in the introduction of parasites and natural enemies has been carried on in the Hawaiian Islands. There is a list of these introductions down to 1923 in an article by O. H. Swezey on pages 299 to 304 of the Proceedings of the Hawaiian Entomological Society, Volume 5. Supplementary to this list, Mr. Swezey published in the Journal of Economic Entomology, Volume 19, October, 1926, a paper entitled "Recent Introductions of Beneficial Insects into Hawaii," pp. 715-720. The number of these parasite introductions proving successful is astonishingly large. It has been pointed out repeatedly that the equable climate of the Hawaiian Archipelago and the fact that it is composed of islands makes success reasonably sure in experiments of this kind, or at all events these conditions offer much better chances for success than a continental region in a more northern or southern location. However, not all of these importations have been striking successes. The Hawaiian work has been written up a number of times by other investigators, but it has never been better done than by

Dr. A. D. Imms, of Harpenden, England, who visited the islands in 1925 and who published an account of his observations in the *Annals of Applied Biology* for August, 1926 (pp. 202-423). This paper is presented in a masterly way, and should be read. He ends with a summary which may well be printed here:

1. Insect pests in the Hawaiian Islands are, with few exceptions, immigrant species from other countries. Their control by biological methods dates from 1890, when A. Koebele introduced *Novius cardinalis* for repressing the cottony cushion scale, *Icerya purchasi*, and the experiment was completely successful.

2. The sugar cane leaf-hopper, *Perkinsiella saccharicida*, has been suppressed by the combined activities of several imported species of Chalcid egg-parasites, followed by the introduction of the predaceous Capsid, *Cyrtorhinus mundulus*, from Fiji and Queensland.

3. Satisfactory control of the sugar cane borer, *Rhabocnemis obscura* has been achieved in most infested areas by the Tachinid *Ceromasia sphenophori*, introduced from New Guinea. In certain districts, under bad climatic conditions, outbreaks still occur and efforts are being made to meet the situation by introducing other beneficial insects.

4. Efficient control of the beetle, *Anomala orientalis* has been obtained by the introduction of the wasp, *Scolia manilae* from the Philippines. This pest has not since increased to its former destructive proportions.

5. The Avocado mealy-bug, *Pseudococcus nipae*, accords one of the most recent examples of biological control. Since the importation of the Chalcid parasite *Pseudaphycus utilis* from Mexico in 1922 this pest has been difficult to find in many districts.

6. The indigenous Pyralid leaf-rollers, *Omiodes accepta* and *O. blackburni*, are no longer pests of serious consequence. They are controlled by several enemies, chief among them being the Braconid, *Macrodyctium omiodivorum* and the Chalcid, *Chalcis obscurata*; both parasites were originally obtained from Japan.

7. Satisfactory repression of the Mediterranean fruit-fly, *Ceratitis capitata*, has yet to be achieved. The importation of parasites from Africa and Australia has markedly decreased the infestation, but their efficiency appears to be partly neutralized by the species competing against one another and supra-parasitism is prevalent.

8. The Australian fern weevil, *Syagrius fulvitaris*, no longer occasions damage to tree ferns to its former extent. The recent introduction of the Braconid *Ischiogonus syagrii* from Australia has brought about this result.

9. Early introductions of the various Coccinellidae, more particularly of *Cryptolaemus montrouzieri* and *Coclophora inaequalis*, resulted in the complete subjugation of certain coccids and aphides.

10. Promising results are being obtained against army worms and cutworms by the recent introduction of the Chalcid *Euplectrus platyhyphenae* from Mexico. The breeding and liberation of this parasite are still being carried out.

11. Control of wireworms and the horn fly has not, so far, met with success.

* * *

It seems that more than 90 different species of beneficial insects have been successfully introduced into Hawaii from other countries.

Mr. O. H. Swezey published a complete list in 1925. Of course these 90 species by no means comprise all that have been introduced experimentally into the islands. As Doctor Imms points out, the far greater number of species have failed to become established. A complete list is not available, but many are recorded. It is not fair, however, to report these as failures. Doctor Imms treats this question very well in the following words: "In judging the success or failure of these experiments it should be pointed out that the objective is to bring about a reduction in the numbers of the pest concerned. If, for example, introductions are attempted with 10 different species of parasites and only two species succeed in establishing themselves and these two are effective in restraining the host, the experiment is to be regarded as successful. It is wide of the mark to say that there were eight 'failures.'" It is probable that a large proportion of the eight could have been established with continued experiment, but it was not deemed worth while to do so, since the desired end had been met by the establishment of two. Also, by our experience in this country, it is altogether likely that many of the species not considered as having been established will turn up one of these days. We have known and recorded instances in this country where this has happened even after 20 years.

Before leaving the subject I wish to call especial attention to the fact that the Japanese rice borer, *Chilo simplex*, was first observed in Hawaii in the autumn of 1927. It was probably introduced from Japan in rice straw used as packing for merchandise. Attempts have been made to introduce the natural enemies of this insect from Japan, and the following species have been liberated: *Phanurus beneficiens* Zehnt., *Trichogramma japonicum* Ashm., *Amyosoma chilonis* Vier., and *Apanteles* sp. It is especially to be hoped that these parasites will take hold, since the United States is threatened by the same pest. Rice straw packing frequently arrives at Pacific ports with active living larvae of the Chilo. The objects packed are frequently very cheap affairs intended for the ten-cent stores, and they are therefore sent all over the country. Is this Chilo already breeding in United States territory? I fear so.

ITALY

Prospaltella berlesci How. was sent to Berlese in Italy from the United States Bureau of Entomology in Washington in 1908. In 1913 Berlese reported its absolute success, its wonderful spread and destruction of the mulberry scale. In the meantime Silvestri had been introducing into Italy a number of Coccinellids. In 1913 he reported

that he had introduced *Rhizobius lophanthae*, *R. ventralis*, and *Orcus chalybaeus*. These are all Australian species that Koebele had sent to California, and Silvestri introduced them into Italy to prey upon *Chrysomphalus* scales. He also introduced the ladybird *Hippodamia convergens* from the United States as an enemy of plant-lice.

Silvestri had at that time been on a trip for the Hawaiian Government, and in Africa he had found *Galesus silvestrii* Kief. and *Dirhinus giffardii* Silv. and had introduced them into Hawaii against the fruit-fly. He also introduced both species into Italy for the same purpose and found that they bred in the olive fly.

In 1914 Silvestri went to Eritrae to collect parasites of the olive fly. He found that this fly is subject to natural control in Eritrae and that insects are an important factor. He found several species of Braconids and Ichneumonids, and a number of them were brought back to Italy.

In 1916 Berlese and Paoli reported upon and described *Prospaltella lounsburyi*, a native of Madeira, sent to them by Prof. C. P. Lounsbury, which attacks *Chrysomphalus dictyospermi*. (In 1920 Paoli and Masi showed me this parasite at Genoa and indicated the characters separating it from my *P. berlesci*. I think it a sound species.)

In 1917 an agreement was made between the Italian Ministry of the Colonies and the Italian National Society of Olive Growers whereby a collection of *Opius concolor*, an important parasite of the olive fly, was made in Tripoli. Some of these were sent to Silvestri's laboratory at Portici for breeding, and over 3,000 individuals were released in the winter of 1917-18.

I am sure that the indefatigable Silvestri has made other importations of beneficial insects into Italy, but I have seen no record of them.

JAPAN

I have seen no account in English of the appearance of *Icerya* in Japan before 1911. In the Bulletin of Plant Pathology and Injurious Insects of the Department of Agriculture and Commerce at Tokyo for November 25, 1917, is an unsigned article stating that *Icerya* appeared in the prefecture of Shizuoka in 1911. The ladybird *Novius* was soon introduced and was carefully studied. The success of the importation was marked. The anonymous author makes the statement that the *Novius* also fed upon *Icerya seychellarum* and *Monophlebus corpulenta* in Japan. This is interesting, since the famous Australian ladybird is usually said to be monophagous.

In 1925 and again in 1926 attempts were made to acclimatize *Aphelinus mali* in Japan. The first one failed, and it is altogether likely that the second one failed as well. This attempt was made by Professor Kota Monzen of the Imperial College of Agriculture and Forestry at Morioka.

Under Formosa, we have referred to the attempt by Ishida to introduce *Encarsia flavoscutellum* and his eventual success.

Scutellista cyanea, originally brought from South Africa to destroy the black scale was introduced much later from California into Japan where it attacked Lecanium and also two species of wax scales; but attempts to establish it on *Ceroplastes* on Citrus in the field proved unsuccessful.

JAVA

In 1918 *Cryptolacmus montroussieri* was introduced by P. van der Goot from Hawaii into Java to combat the coffee mealy-bug (*Pseudococcus virgatus*). The insect bred in Java for two years, but did not increase at all rapidly. In 1925 J. Gandrup reported that it had become established throughout eastern Java but that its practical value had not been tested, as climatic conditions had prevented any outbreak of the pest.

MALAYA

In 1922 the coffee growers of Java alarmed at the ravages of the coffee berry beetle (*Stephanoderes hampei*), raised a fund and sent J. den Doop to Uganda to search for parasites. He remained in Uganda during 1923 and 1924 and discovered two parasites, namely *Heterospilus coffeicola* Schmied. (a Braconid) and *Prorops nasuta* Waterst. (a Bethyloid). On attempting importation in Java, he failed with the Braconid but succeeded with the Bethyloid. However, although the species was established, it did not check the pest as hoped, and further trials were discontinued.

MALTA

Icerya purchasi broke out in Malta in the spring of 1913. *Novius cardinalis* was introduced, and the spread was checked almost immediately.

MAURITIUS

Doctor Trouvelot, in his list, mentions the introduction of Madagascar Scoliid wasps to parasitize the beetle borer of sugar cane. D'Emery de Charmoy was sent from Mauritius to South Africa and

remained there from November, 1913, to February, 1914, studying insects. He attempted to introduce *Novius* from South Africa into Mauritius, but failed. He also attempted to introduce a Hymenopterous parasite of a cutworm, but failed. He also tried to introduce certain Scoliid wasps from Barbados, but apparently failed. In 1915 he reported a further attempt to introduce the Barbadian wasp (*Tiphia parallela*) and mentioned the fact that inquiries were being made in Madagascar where two promising species of *Tiphia* were reported. In 1917 he introduced one of these wasps, *Scolia oryctophaga*, and assured its persistence by the presence of certain flowering plants upon the nectar of which the wasps fed. Four other species of Scoliid wasps were introduced from Madagascar, according to this report of 1917.

In 1927, de Charmoy in his report stated that, although the total area of sugar cane infested by *Lachmosterna smithi* was about 41,000 acres, only 2,500 acres were actually damaged. Control measures, particularly the introduction of the parasite *Tiphia parallela*, were responsible. I believe that the Madagascar wasps were equally successful against the *Oryctes*.

NEW ZEALAND

In his "History of the Introduction of Beneficial Insects into New Zealand" read at the Pan-Pacific Scientific Congress at Melbourne in 1923, R. J. Tillyard shows that a Mantis, *Orthodera ministralis*, was introduced accidentally some time previous to 1860; and that an Australian Ichneumon fly, *Lissopimpla semipunctata*, was also accidentally introduced. He lists the other, purposeful, importations of ladybirds from Australia and California. For example, Doctor Miller calls my especial attention to the fact that the Eucalyptus scale, *Eriococcus coriaceus*, a native of Australia, became in 1900 a serious pest of Eucalyptus trees growing in New Zealand but was soon controlled after the ladybird, *Rhizobius ventralis*, was imported from Australia by Kirk and liberated in New Zealand. Tillyard also mentions the fact that the European parasite, *Callicphialtes messor*, of the codling moth, that had been introduced into California by Compere from Spain, was introduced into New Zealand in 1906. Doctor Miller tells me that this importation eventually proved to be a flat failure. According to Tillyard, *Entedon epigonus* and *Platygaster minutus* were in 1893 introduced from England against the Hessian fly. He mentions also the introduction of *Aphelinus mali* from the United States and the great success that it had in New Zealand. An interesting little Chalcidid parasite, *Habrolepis dalmani*, was several

times introduced from the United States by Tillyard, with the help of the United States Bureau of Entomology, to destroy the golden-oak scale, an insect that was doing great damage in New Zealand. Several attempts to establish this species failed, but I am now informed by Doctor Miller that the parasite has assumed complete control of the scale. This success is largely due to the work of Mr. E. S. Gourley, of Doctor Miller's staff. One of the European parasites of the European earwig has also been introduced from England. Grass-grub parasites have been imported from Australia.

In 1926 Tillyard published another paper on the same subject, with no additional facts.

D. Miller, in the New Zealand Journal of Agriculture, June 21, 1926, reports on the finding by R. C. Fisher and J. G. Myers of two parasites of the pear midge (*Perrisia pyri*) in the South of France—the one a species of *Platygaster* and the other a species of *Inostemma*. Colonies were sent to New Zealand in 1925, and the parasites emerged in December and January. The *Platygaster* bid fair to become established.

Later in the same year Doctor Miller published the statement that the *Platygaster* sp. referred to above is *Misocyclops marchali*. The parasite seems to have come out well, 66 per cent being females. J. Muggerridge reported in 1929 that, although this insect survived two or three winters, it had not exercised the degree of control that had been hoped for, even in the orchard where the main liberation took place.

In 1926 and 1927 New Zealand imported three consignments of larvae of *Lachnosterna* parasitized by the Tachinid, *Microphthalma michiganensis*, from Canada.

In 1927, Doctor Miller reported the direct sending from Australia to New Zealand of a consignment of the eggs of the Eucalyptus weevil parasitized by the same Mymarid¹ that was later imported from Australia into South Africa and also into Argentina. Doctor Miller tells me that in the 1929-30 season it became established and has the weevil under control.

Quite recently the little Hymenopterous parasite, *Alysia manducator*, has been imported for use against the so-called "wool maggots" and is giving promising results. Doctor Miller tells me that during the 1929-30 season this parasite has been found breeding naturally in the field.

¹ Described by Ch. Ferrière, Bulletin of Entomological Research, London, Vol. 21, Part 1, March, 1930, pp. 38-39, as *Anaphoides gonipteri* n. sp.

THE PHILIPPINES

In 1928 L. B. Uichanco published the statement that the Javanese parasite (*Encarsia flavoscutellum*) of the woolly aphis (*Oreigma lanigera*), that had been introduced from Java into Formosa, was later introduced from Java into the Philippines.

Aside from this introduction from another country, most interesting work has been done with presumably native parasites by Dr. W. Dwight Pierce in the Island of Negros, but this is described rather fully in our section on the Philippines in an earlier part of this book.

PORTO RICO

In 1917 E. G. Smyth made a study of the possible enemies of the white grubs injuring sugar cane on the island. He listed 15 North American insects parasitic upon *Lachnosterna*, and urged their introduction into Porto Rico. In the Journal of the Department of Agriculture of Porto Rico for January, 1922, G. N. Wolcott reports on insect parasite introduction into Porto Rico. An attempt was made to introduce *Tiphia inornata* from the United States. All attempts failed. There was a similar failure with *Elis collaris*. *Tiphia parallela* was introduced from Barbados, but did not breed. *Cryptolaemus montrouzieri* was introduced, and easily became established; but there was a failure with an undetermined Tachinid from Illinois.

Later, Mr. Harold E. Box, working for the Central Aguirre Sugar Company, attempted for several years to find and introduce suitable parasites of sugar cane insects. Mr. Wolcott's attempts at the establishment of such parasites from the mainland of North America having failed, Mr. Box visited the Guianas and Venezuela and collected a number of parasites that were introduced into Porto Rico.

QUEENSLAND

In 1921 or 1922 a predacious Histerid beetle (*Placisius javanus*) was introduced from Java into Queensland to prey upon the banana beetle borer. Three years later (Queensland Agricultural Journal, December 1, 1925) Mr. J. L. Froggatt, writing of this insect, stated that there was at that time no evidence that it would become established in Queensland.

SOUTH AFRICA

Professor Lounsbury of South Africa was impressed by the importance of the introduction of natural enemies of injurious species, and in 1905 went to Brazil with Claude Fuller in an effort to secure

natural enemies of the fruit-fly that George Compere had found there and had introduced into Western Australia. The expedition was a failure, as no effective enemies were found.

Professor Lounsbury interested himself very much in these importation questions. In his report for 1908 he mentions an attempt to introduce the *Calliephialtes* parasite of the codling moth from Spain; and also mentions the fact that he was trying to import a parasite of the red scale from West Australia, but he does not mention the name of the parasite. Also in that year he attempted to introduce a parasite of ticks from Texas, *Hunterellus hookeri* How., but the issuing parasites ignored the Cape of Good Hope ticks that were offered to them. In his report for 1909 he referred again to the Spanish parasite of the codling moth and once more to the same tick parasite.

In a circular published in 1917 (Local Series No. 24) Lounsbury refers to the damage done by *Phoracantha semipunctata*, known as the firewood beetle, to Eucalyptus logs probably introduced into South Africa from Australia in newly cut railway sleepers. He stated that in its native country this beetle has important parasitic enemies not occurring in South Africa, and adds, "and attempts cannot be made to introduce them until shipping facilities become normal."

In 1920 *Aphelinus mali* was sent to South Africa by Mr. A. E. Lundie, then studying at Cornell University. There have been variable results in different parts of the country, some apparently very good.

In his report for 1922 it appears that parasites of the codling moth had been introduced from America and established in South Africa, but no further information was given.

In 1924 it was reported that attempts to establish three Italian parasites of the codling moth in South Africa failed. Neither *Calliephialtes*, *Pimpla*, nor an egg-parasite of the genus *Ascogaster* proved of any practical value.

In 1926 the Mymarid parasite of the Eucalyptus snout-beetle was brought over from Australia early in the year, became established during the summer, and succeeded in over-wintering in all parts of the country where introduced. During the summer of 1927-28 these parasites were liberated throughout the infested area in the Transvaal, Orange Free State, and Natal.

SPAIN

In 1923, as reported by M. Aullo, *Schedius kuzanac* How., an egg-parasite of the gipsy moth, was imported from the United States into Spain.

In 1923 also the Agricultural Department of Catalonia, Spain, introduced *Opius concolor* from Tripoli for use against the olive fly. Eight thousand two hundred and twenty individuals of the parasite were received and liberated.

In the same year *Novius cardinalis* was also introduced to check *Icerya*.

In 1926 R. Garcia y Mercet discussed the parasites of the red scale that had been imported into Spain from Menton, France, and from Chiavari, Italy—all Aphelinines, originally received in Italy from Madeira and in France from the United States.

In 1926 or 1927, *Cryptolaemus montrousieri* was introduced from Menton at the Phytopathological Station at Valencia, Spain. In 1928 it was reported to have become established and to have already done good work.

SWITZERLAND

In 1923, *Aphelinus mali* was introduced from Germany into Switzerland.

Icerya purchasi made its appearance in 1924 on Acacia and Citrus at Tessin. *Novius cardinalis* was imported from Menton, France, with its usual success.

UNITED STATES OF AMERICA

The United States Bureau of Entomology.—The early efforts of the United States in this direction have for the most part been indicated in Doctor Trouvelot's list, but something additional may be said. The early importation of *Novius cardinalis* from Australia was a Federal matter. The credit must belong to Professor Riley who conceived the idea, conducted the preliminary correspondence, and selected from the paid employees of the Department, Albert Koebele to make the trip, and D. W. Coquillett to receive and care for the material in southern California. Koebele made a second trip a year or so later, at the expense of the State of California, but still retaining his position in the Federal Bureau, and imported several other Coccinellids, notably *Cryptolaemus montrousieri* which has proved to be such a great success in many parts of the world against mealy-bugs. He also sent over *Orcus chalybeus* and *O. australasiac* to prey upon the red scale and also upon the black scale, but neither of these species seems to have maintained itself in California.

Another of the instances listed by Doctor Trouvelot should be mentioned a little more fully: Dr. R. S. Woglum was sent to India in 1910 to search for a parasite of the so-called white fly of the

orange, very destructive in California. After extended search he sent the Coccinellid *Cryptognatha flavescens* from Saharanpur, but they died in transit. Later he found an internal parasite at the same place and at Lahore. This species was described by the writer as *Prospaltella lahorensis*. Small infested orange trees were placed in Wardian cases and sent to Florida. Eight adults and several pupae survived the journey, but they arrived at the wrong time of the year and perished, the white flies being then in the dormant pupal condition. It was upon this trip that Doctor Woglum debarked at Gibraltar and went up to Valencia, Spain, to demonstrate to the Spanish agricultural engineers the proper way to fumigate Citrus trees for scale insects.

The introduction from France of the egg-parasite of the European elm leaf beetle, which was begun in 1905, has been repeated several times since then, but the species has not taken hold in the United States. It apparently existed through a whole year at Melrose Highlands, but eventually died out. There is a bare possibility that it may have persisted in some one of the numerous places in which it was liberated, but it has not been found. An especially favorable place was found several years ago on a badly infested clump of European elms on the estate of Admiral Taylor of the United States Navy at Gordonsville, Virginia. It was hoped that at this place the parasites would take hold, but there has been no observable result as yet, and the fine old trees, I am told, are in their last stages.

In 1924 a Dipterous parasite (*Erynnia nitida*) was introduced from the South of France with the aid of W. R. Thompson, then stationed at Auch. Specimens sent to Washington were liberated on Admiral Taylor's place, but the species has not been recovered.

The very large-scale experiments made by the Bureau in the introduction of many parasites and predators of the gipsy moth and the brown-tail moth from Europe as well as from Japan were fully described in 1911 in Bulletin 91, and need be given no space here. Shorter bulletins have been published from time to time giving accounts of the progress of individual imported species, and Technical Bulletin 86 of the United States Department of Agriculture, published in August, 1929, gives a full account by A. F. Burgess and S. S. Crossman of the status of the many importations down to that date.

Two other large-scale attempts to import natural enemies of injurious insects of extreme importance have been made by the Bureau, one the bringing in from Europe and from the Orient of the parasites of the European corn borer. The progress of this attempt has been

displayed in various publications of the Bureau of Entomology. The other large-scale attempt has been to bring over from Japan, China, and India the natural enemies of the so-called Japanese beetle, and the progress of this effort has also been shown in various publications of the Bureau. One especially interesting feature of this work, although it was a failure, was the shipment of 900 eggs of *Ithone fusca*, a Neuropteroid insect, sent by Dr. R. J. Tillyard from New Zealand. This shipment was received December 3, 1921. This insect, in its larval state, preys upon soil-inhabiting grubs, and Doctor Tillyard has written a very striking account of its swarming at certain times in Australia. These eggs were held over in the spring of 1922 in cold storage. A number hatched, but the larvae all died before reaching the second instar. I am informed that it is planned to send an expert to Australia in the autumn of 1930 to search for desirable enemies of white grubs and this species will be among those sent to this country if possible.

An attempt about which little has been published down to the present time is that of bringing over from Europe two Tachinid flies, *Digonichaeta setipennis* and *Rhacodineura antiqua*, both parasites of the European earwig. Puparia of these flies have been collected in the south of England and the south of France, and quantities of living earwigs of which a certain proportion were probably parasitized by these insects have been sent to Portland, Oregon, and placed in specially prepared insectaries under the charge of Mr. H. C. Atwell, a State official. They have not bred freely in confinement, and although many have been liberated no striking results have been reached as yet.

One of the rather large projects of the Bureau of Entomology was the introduction from Europe of parasites of the alfalfa weevil. A summary of these attempts was published as Circular No. 301 of the United States Department of Agriculture, April, 1924. The author was T. R. Chamberlin, who spent the summer of 1923 in Europe making an especial study of these parasites. Even before the great war, however, several species had been introduced through the efforts of W. F. Fiske and W. R. Thompson who were sent in 1911-12 to Italy and the South of France for the purpose. Only one of these species (*Bathyplectes curculionis* Thoms.) at that time established itself in Utah and has since multiplied and spread at the expense of the weevil to a very considerable extent.

In 1919 an attempt was made by Mr. T. E. Holloway, an agent of the Bureau, to introduce a Tachinid fly, *Euzenilliopsis diatraca*, from Cuba into Louisiana to destroy the sugar cane borer. This expedition was sent at the expense of the Louisiana planters.

In 1923, E. G. Smyth was sent to Mexico to search for parasites of the Mexican bean beetle. He found an effective Tachinid parasite, *Paradexodes epilachnac*, and sent 2,000 living puparia. An attempt was made to hold these insects over at Birmingham, Alabama, and to colonize them. This effort was not successful.

California.—We have elsewhere told of the unfortunate situation that resulted from the overwhelming success of the importation of *Novius cardinalis* into California. For years after that time a very large element of the fruit-growers and farmers were greatly inclined to rely upon natural enemies, and much work on the part of unskilled agents of the State was wasted and large sums spent in traveling were likewise wasted. Many profitless introductions were made, and several that were very unwise and most unfortunate. Only one of these unwise importations, however, turned out to be rather disastrous, namely *Quaylea whittieri*, which proved to be a secondary and destroyed useful parasites of the black scale; but it is a mere matter of luck that great harm was not done by others. One of the last greatly advertised importations was the introduction from Spain into California in 1904 by George Compere of an Ichneumonid parasite known as *Callicphialtes messor* Grav. The most glowing prophecies were made, and the statement was repeated again and again that no more spraying for codling moth would be necessary; but, although the species was reared successfully in confinement in the insectary, it failed to take hold in the orchards and so far as is known never did any good. The next year the law of August 5, 1905, was passed, and this law enabled the Department of Agriculture to prevent such importations as the State had been making; and the work of the State in this direction would have been stopped by order of the Secretary of Agriculture had it not been for the fact that just at that time Prof. A. J. Cook was made Director of Horticulture for the State and appointed Harry Scott Smith, a trained entomologist who had been working in the Parasite Laboratory of the United States Bureau of Entomology in Massachusetts, to take charge of the parasite work for the State.

Mr. Smith, on taking this position, was made an official collaborator of the United States Department of Agriculture, and therefore in a way his subsequent efforts in this direction may be said to have been in cooperation with the Federal Government, or at least to have been tacitly authorized by the Federal Government.

The subsequent efforts of the State of California in this direction have been written about by Mr. Smith and have been published from time to time. For example, in the Monthly Bulletin of the California

Commissioner of Horticulture for December, 1915, he lists the beneficial insects imported during the period in which he was connected with the State Insectary. Later Mr. Smith was appointed a professor in the University of California and was sent to Riverside where he has since worked at the great Citrus Experiment Station. He went himself to the Orient in 1912 and 1913. He has reported on a number of interesting introductions. In 1913 he reported *Scymnus bipunctatus* from the Philippines. In 1914 he reported upon the importation of black-scale parasites from South Africa. Eleven species of undetermined parasites were said to have been reared from this material, two of them in considerable numbers. Two of the primary parasites issued from a young scale before the eggs were laid, and were expected to become valuable supplements to two of the other parasites of the older scales, both of which attack them after the eggs are laid.

In 1914 the State of California maintained a laboratory at Palermo, Sicily, in charge of H. L. Viereck. He sent over mealy-bugs and from these were reared *Paraleptomastix abnormis*, Girault. Breeding proceeded rapidly, and before many months large colonies were placed in the orchards of southern California. H. S. Smith reported in 1917 that the parasite was thriving and increasing rapidly in all the field colonies. He thought that it would become of great economic value. One interesting thing about this parasite is its apparent resistance to fumigation.

In 1916 Mr. Smith reported the very recent introduction of two Coccinellids from Japan—*Chilocorus similis* which feeds upon Coccids, and *Ptychanalis oryridis* which feeds voraciously upon all plant-lice.

In the same year he reported that *Ootetrastichus beatus* had been received from Hawaii for use against the sugar beet leaf-hopper in California.

Also in 1916 it was reported by Mr. Smith and H. Compere that the fly, *Lestophonus iceryae*, introduced by Koebele at the same time as *Novius cardinalis*, in the lapse of years increased very slowly until at the time of writing, in some places, especially on Acacias, it has been a more important factor in the control of *Icerya* than the lady-bird.

The same men in 1920 wrote about the establishment of *Aphycus lounsburyi* in southern California. It had been liberated in September, 1919, from material received from South Africa.

In 1923, Mr. Smith imported into southern California the South African Coccinellid *Scymnus binaevatus* to feed upon mealy-bugs. Several previous unsuccessful attempts had been made with this beetle.

In 1924 Harold Compere reported on the rearing, from Japanese material, of four primary parasites of the so-called Citricola scale.

Coccophagus modestus, introduced from South Africa into California as a primary parasite of the black scale, is considered in South Africa to be one of the most effective enemies of this scale. According to Smith and Compere, in a bulletin published in 1926, its establishment in southern California was successful.

Mr. Harold Compere went to Australia in 1928. Among other important material, he brought back *Coccophagus gurneyi*, a species that in New South Wales is parasitic on four different species of mealy-bugs. It was brought to California by Mr. Compere in the hope that it would attack the so-called citrophilus mealy-bug. Writing to me on March 10, 1930, Professor Smith used the following words: "*Coccophagus gurneyi* is a wonder. It looks now as though the citrophilus mealy-bug is doomed. Many groves have been completely cleaned up of the mealy-bug, and the dead carcasses with exit holes are found by the millions on the trees. I think we are about to witness another very successful case of biological control."

URUGUAY

When the Defensa Agrícola was created in 1911 there had been much damage for some years to peach trees by *Diaspis pentagona*. Ing. Roberto Sundberg immediately investigated the question of its natural enemies. He visited the United States and Italy in 1912, and branches carrying parasitized scales were sent to him in Uruguay both from the United States and from Italy. With careful handling and prompt distribution, the parasite (*Prospaltella berlesci*, How.) was speedily acclimatized, and at the present time the scale is virtually held in check. The peach orchards, which were practically ruined, recovered in a short time, and Uruguay produces a large crop and is in the way of exporting peaches. Through the Defensa Agrícola, the same parasite was sent to Argentina.

In 1915 *Icerya purchasi* was discovered in Uruguay. Colonies of *Novius cardinalis* were sent from Portugal, but without success. In 1919 a technical man was sent to Europe and secured a colony of the *Novius* at the Insectorium at Menton, France. He personally carried this shipment back to Uruguay, but only five adult beetles survived the journey. From these individuals, however, in the course of two months thousands of adults were reared and widely distributed, so that within a year the infestation was practically under control. The Defensa Agrícola sent colonies of the *Novius* to Sao Paulo, Brazil, and to Argentina.

In 1920 *Aphelinus mali* was sent from the United States to Uruguay, and the insect was speedily reared and acclimatized and holds the woolly root-louse of the apple in check. Colonies of this parasite were sent from Uruguay to Argentina, Chile, England, Italy, and Germany.

WORK IN ENGLAND FOR THE BRITISH COLONIES

We have elsewhere referred to the founding of the Parasite Laboratory of the Imperial Bureau of Entomology at Farnham Royal, England. This Bureau, supported largely by the Empire Marketing Board, was established for the purpose of breeding parasites that might be useful to the different British colonies or dominions. Dr. S. A. Neave was the first Director of the Laboratory, but was later succeeded by Dr. W. R. Thompson, for a number of years in charge of the United States Bureau of Entomology laboratory at Hyères, France.

An article entitled "Breeding of Beneficial Parasites" was published in the journal *Science* February 8, 1929, which gave an account of the work of the Parasite Laboratory of the Imperial Bureau of Entomology. It was stated that parasites of the pine Tortrix, the greenhouse white fly, and of the Coccid, *Lecanium coryli*, had been sent to Canada; *Rhyssa persuasoria*, a parasite of Sirex, to New Zealand; three species of parasites of the pear slug to New Zealand and Australia; a parasite of the woolly apple aphid to India and Kenya, and parasites of the earwig to New Zealand and Canada.

THE USE OF INDIGENOUS PARASITES: DR. THOMPSON'S PAPER ON BIOLOGICAL CONTROL

Except for its earlier paragraphs, this present chapter has dealt almost entirely with international introductions of useful insects. Little, in fact, has been done of comparatively recent years in the transfer of parasites from a point where they are abundant to points where they are scarce or absent in the same country or in the same general area. Nothing has been said, moreover, about the intensive breeding of parasites in enormous numbers for practical use in the same general locality.

Reference has been made many times to the old European gardeners' practice of collecting ladybirds (Coccinellidae) and placing them on plants subject to attack from aphids. And the suggestion was made by many early authors that the parasitized larvae or pupae of certain injurious insects be kept to allow the parasites to escape.

The Californians for some years carried on spectacular work with Coccinellids collected by the hundreds of thousands during their resting period in the mountains and that were carried down into the valleys of the southern part of the State to destroy plant-lice in the large melon fields. S. J. Hunter in Kansas tried once to breed up aphid parasites to control the grain aphid when it supposedly invaded Kansas wheat fields from the South. And F. M. Webster, while working for the United States Bureau of Entomology, had parasitized puparia of the Hessian fly collected in Pennsylvania and exposed in infested fields in Maryland with encouraging results. The parasite (*Polygnotus hiemalis*) apparently established itself immediately to good effect in the Maryland field. Under W. D. Hunter, parasitized boll weevils were carried successfully from Waco, Texas, to Dallas, Texas, and from Texas into Louisiana, with the result that the mortality of the weevil was increased in both localities to which the parasites had been taken.

It is surprising that more of this work was not done at an earlier date. The writer well remembers that in 1896, when practically all the shade trees in the District of Columbia were damaged by larvae of the white-marked tussock moth, there developed an enormous number of parasites in the northwest quarter of the city which in the other sections were scarce or entirely lacking. It would have been easy to supply the suffering sections with an abundance of parasites from the northwest section. The emergency passed, however, without action of this kind, and, although the damage to the trees lasted a season longer in the quarters lacking parasites, other factors combined to lessen the injury during the following years. At all events, the damage ceased.

The men in the tropical research laboratories in Cuba have noticed that the sugar cane borer is sometimes held down to some extent by its parasites in certain restricted regions while miles away parasites are lacking. Transfers in bulk of parasites are plainly indicated.

As I am writing this Dr. W. Dwight Pierce, who has been employed for a year or more by two of the great sugar companies on the Island of Negros, has visited Washington. He has told me some very interesting facts about the transfer of parasites in the sugar cane fields from particular points where they abound to other points in the same general area. He has in this way a number of times increased very greatly the percentage of parasitism of the prevalent sugar cane borers. His reports when published will undoubtedly be of great interest.

Another rather extraordinary example of successful transfer of indigenous parasites is apparently just being brought about at Halsey,

Nebraska, on an experimental reforestation area in the sand hill country. The reforestation is in the Nebraska National Forest, and the work is being done by the United States Forest Service. With the coniferous trees used in this experiment, an eastern injurious insect, one of the so-called tip-moths (*Rhyacionia frustrana*), was accidentally introduced and flourished to such an extent as to threaten the death of all the young trees. In the East an Ichneumonid parasite (*Campoplex frustranae*) was known, and colonies of this parasite were taken from East Falls Church, Virginia, to Halsey, Nebraska, and liberated in the infested area. Doctor Craighead, in charge of the forest insect work of the United States Bureau of Entomology, reported in the summer of 1929 that in the areas where the parasite was first liberated parasitism had increased to as much as 80 per cent and the percentage of destroyed tips had decreased from 90 per cent to less than 30 per cent; a definite improvement in the appearance of the trees was discernible, and there was promise that the parasite would be the solution of the very difficult problem. Later information confirms that promise. The expert in charge of the work, to whom much credit should be given, is Mr. Lynn G. Baumhofer of the Forest Insects Section of the Bureau of Entomology. The trees planted on the area were largely Austrian, Scotch, and yellow pine.

The extraordinary work that has been done in several parts of the world with *Trichogramma minutum*, an egg-parasite of a large number of injurious insects, has attracted great attention of late years. The mass breeding of this useful parasite has been carried to an extreme in southern California by Mr. Stanley Flanders who has simplified and economized the work by using one of the common meal moths as a breeding stock, the resulting parasites being distributed to walnut growers to parasitize the eggs of the codling moth. Moreover, Mr. E. R. Speyer, who has been studying the greenhouse white fly in England for several years, has reared one of its parasites (*Encarsia formosa*) on a very large scale for distribution to greenhouses in the early part of the season at a time when fumigation would injure the younger plants.

This sort of work, verging upon the actual domestication of beneficial forms, is undoubtedly important and will assume more importance as time goes on.

This whole question of the practical use of parasites and predatory insects is considered by Dr. W. R. Thompson in a just-published paper entitled "The Principles of Biological Control" (The Annals of Applied Biology, May, 1930, Vol. 17, No. 2, pp. 306 to 338). Doctor Thompson has been working upon problems of this nature for

many years. A Canadian by birth and education, he joined the force of the United States Bureau of Entomology and was engaged in parasite work at the Gipsy Moth Laboratory in Massachusetts. He afterwards went to Europe among those who first searched for the parasites of the alfalfa weevil, a European insect that had been introduced accidentally into the Utah fields. After the World War, for some years he had charge of the European end of the work carried on by the Bureau of Entomology in the study and importation into the United States of the European enemies of *Pyrausta nubilalis*, the well known European corn borer. Later, as we have elsewhere pointed out, he took charge of the important Parasite Laboratory of the Imperial Bureau of Entomology at Farnham Royal. All this time he has been studying these questions of natural control, and this last work of his is authoritative and suggestive to a very great degree. He is one of the early and foremost users of mathematics as applied to biological problems, and in this last paper the whole question is studied more or less from its mathematical end.

His summary, covered in 11 points, seems perfectly sound, although, having a non-mathematical mind, I have reached my conclusions in a somewhat different way. Those especially interested should by all means consult this paper, and it will be unnecessary here to quote even the rather long conclusions. Doctor Thompson's No. 11, however, will serve very well to close this chapter:

Generally speaking, no one species of parasite or predator is likely to bring the host under control over the whole of the infested area. To produce this result, the introduction of additional species will usually be necessary, while in many cases, their efforts must be aided by the methods of agricultural, chemical, or mechanical control.

IMPORTATION OF THE INSECT ENEMIES OF WEEDS

It has happened a number of times that when intentionally or accidentally imported plants have become weeds suggestions have been made that their natural enemies be introduced from their original homes. Such suggestions have been made not only in this country but in others. I remember that many years ago when the Russian thistle was spreading rapidly in the northwestern United States the United States Department of Agriculture was called upon for assistance in importing insect enemies of the plant from Russia. Knowing, however, that a number of the insect enemies of thistles affect cultivated plants, I advised against any such attempt, and none was made.

The case was quite different, however, when certain cacti of the genus *Opuntia* escaped from cultivation in Australia and overran

large acres of valuable grazing land. It seems unlikely that any of the insect enemies of *Opuntia* would attack cultivated crops of any value; and therefore the Australians were quite justified in their large-scale attempts to import into Australia and establish there the insect enemies and diseases of the plants of this genus.

A Prickly-Pear Board was established in Queensland, and Prof. T. Harvey Johnston and Mr. Henry Tryon were sent on a world hunt. They visited Washington in 1913, and were advised to go to Texas and consult with W. D. Hunter, F. C. Pratt, and J. D. Mitchell of the United States Bureau of Entomology, who had been studying cactus enemies for some time. Eventually a laboratory for the Prickly-Pear Board was established at Uvalde, Texas, and many important insects were sent over. Cactus-feeding insects were also sent in from other parts of the world. Certain species have become established and have proved very effective, destroying the injurious plants over large tracts of land.

Hawaii, suffering from the increase of the Lantana weed, sent agents to several countries to seek for the insect enemies of this weed. A fly affecting the seed was found and introduced and multiplied to such an extent that the Lantana pest was greatly reduced.

This Lantana seed fly was introduced from Hawaii into Fiji prior to 1916 and was reported in that year by F. P. Jepson to have become so thoroughly established that it was not possible to find Lantana within several miles of Suva that did not display evidence of attack by this insect.

Similarly the same fly was introduced into Queensland from Hawaii, as announced in the Queensland Agricultural Journal for April, 1917.

Australia is not the only part of the world to introduce enemies of *Opuntia*. G. Pettit, in the Proceedings of the French Academy of Agriculture in 1929, announced the successful introduction of *Dactylopius coccus* into Madagascar to destroy *Opuntia vulgaris*. He made the statement that in one large tract of 25,000 acres the cactus was completely destroyed in eight months. In the review, no statement is made as to the place from which the *Dactylopius* was imported.

The destruction of *Opuntia* on the Island of Mauritius by the different imported insects has also been tried.

Dr. R. J. Tillyard for several years before leaving New Zealand for Australia interested himself in the importation of insect enemies of the blackberry, blackberry plants having gone wild over large sections of land and having become a great pest. Doctor Tillyard,

in putting through his idea about introducing the natural enemies of the plant, met with considerable opposition, since the insect enemies of blackberries would also destroy other and more useful Rosaceous plants; but his scientific reputation is so sound that he was entrusted by American and European entomologists with insects for introduction.

In the same way the insect enemies of ragwort, gorse, and piripiri have been introduced into New Zealand. Dr. David Miller reported in 1929 that in three cases the work was still in its preliminary stages, but that, in the case of ragwort, field liberations of the cinnabar moth (*Tyria jacobaeae*) imported from England had already been made.

GROWTH OF APPRECIATION OF ECONOMIC ENTOMOLOGY BY OTHER SCIENTIFIC WORKERS

At first thought it would seem that wide-spread popular appreciation and popular support would be all that economic entomology would need. But there is something else, and that is appreciation on the part of workers in what is known as pure science. And the lack of such appreciation was keenly felt by the earlier economic entomologists. It is difficult in these days to realize the attitude of museum men and university men towards the workers in agricultural entomology even when the former were entomologists themselves. Perhaps they did not realize it to the full themselves, but those of us who were trying to help the farmer in his insect problems felt as though we were classed as outsiders—as farmers ourselves. And most of us realize how the old-fashioned farmer is thought of, even today, in scientific circles.

I think it likely that this attitude of scientific men has persisted even longer in Europe than in this country, although we must remember that in Italy Antonio Berlese and Filippo Silvestri were early elected members of the *Accademia dei Lincei*, the most exclusive of the Italian scientific organizations; and that in France Paul Marchal nearly 30 years ago became a member of the *Académie des Sciences* and thus of the *Insitut de France*. Other instances are not lacking, as view the esteem in which Porchinsky and Cholodkovsky were held in Russia.

But all of these men did work aside from its economic applications that brought them this esteem and these honors. As late as 1902, on my first visit to the National Hungarian Museum, I asked Kertész and Mocsàry about Jablonowski and they replied that he was not a scientific man, he was a farmer, and that I would find him over in

old Pesth. This was only one of many instances and was quite what I might have expected from my general experience.

As appreciation began to come from outside these circles, however, the eyes of the pure scientists began to be opened, not at first to the merits of the scientific work being done by the economic entomologists, but to the fact that they were getting support for their work and that, therefore, if they expected financial support for their own labors they must study the situation more than they had before. A little instance of this was shown me on an early visit to Spain. The Director of the Natural History Museum in Madrid, himself a famous entomologist, Ignacio Bolivar, told me that he had arranged to have one of his aids go to Budapest to study Diptera with Kertész and another one to Germany to study parasitic Hymenoptera with Schmiedeknecht, and that his object was that, since these men could then be in position to identify the parasites of injurious insects, he could secure from his Government more appropriations for the Museum.

In this country and England, while, as we have pointed out, any aspect of entomological work was for very many years considered trivial, there were men here and there who for one reason or another came to command the respect of their scientific colleagues either for their remarkable work with insects or in spite of that fact. Thus, Sir John Lubbock (afterwards Lord Avebury) was early elected to the Royal Society and was a man who commanded great respect from his scientific colleagues. He was President of the British Association for the Advancement of Science in 1881. In the United States, John L. LeConte, S. H. Scudder, and A. S. Packard were elected members of the National Academy of Sciences, an organization which may be compared in a way to the Royal Society of England, the Académie des Sciences of Paris, and the Academia dei Lincei of Rome—LeConte as an incorporator, Scudder in 1877, and Packard in 1872. LeConte, by the way, was President of the great American Association for the Advancement of Science in 1874. These were decided recognitions on the part of scientific men of individual entomologists, but none of them were interested in economic entomology at the time when these honors came to them, although it is true that Packard subsequently wrote concerning the injurious insects of Massachusetts, became a member of the United States Entomological Commission and wrote a large volume on forest insects.

Appreciation of economic entomology and economic entomologists, although very slow in coming, appears now to be increasing rapidly. Although for many years I had been Secretary of the American Asso-

ciation for the Advancement of Science, my first realization of this fact came to me at the Second International Congress of Entomology in Oxford in 1912. Economic entomology was only one of a number of sections of the Congress, and I had been made President of the first session of this section. In view of the fact that the attendance at the Congress was composed largely of morphologists and taxonomists, I had supposed that the section on economic entomology would be poorly attended, and was therefore surprised and gratified on entering the room to find that nearly every seat was taken. It was thus plainly shown that the admirable scientific work done by the economists during the preceding few years had brought about a change of sentiment and a real interest in the applications of the science.

The Third International Congress of Entomology was to have been held in 1915, at Vienna, but the World War came on in 1914 and all thought of international congresses was lost for nearly 10 years.

There is no doubt that the war showed in many directions the usefulness of the economic entomologist. A knowledge of medical entomology naturally played a great rôle, as it always does where masses of men are brought together for any purpose. But perhaps it was especially in the loss of food supplies through insects that entomology was most insistently brought into view. The necessity of bringing together enormous quantities of stored food supplies facilitated greatly the multiplication of insects that live in such products, while the extreme necessity for the production of food by agriculture made the loss through the work of insects on growing crops a matter of enormous importance.

Many of these things are brought together in an article entitled "Entomology and the War" published in the *Scientific Monthly* for February, 1919. It was during the war, it may be stated incidentally, that the Federal Bureau of Entomology began its system of recording closely the increase of crop pests all over the country.

At the close of the war there was a period of several years during which the deep animosities which had been engendered remained too strong for rapprochement to be thought of between even the scientific men of the opposing nations. In fact, I believe it was not until 1923 when English, French, Belgian, Italian, and American workers in entomology first met in international conference with German, Austrian, Hungarian and other nationalists of recently established countries formerly under the dominion of the Central Powers. This meeting occurred at Wageningen, Holland, and brought together both applied entomologists and phytopathologists, and the object of the conference

was wholly practical—economic. The idea originated in Holland, and it is fair to suppose that the inciting idea was suggested by the promulgation of Order No. 37 of the Federal Horticultural Board of the United States Department of Agriculture, which seemed to weigh especially against the bulb-growers of Holland. The selection of the present writer as Honorary President of this international conference was probably thought to be a diplomatic move. The office was accepted with pleasure, although as a matter of fact I had no official connection with the Federal Horticultural Board and no official influence over its actions.

It was interesting to study the German, Austrian, and Hungarian delegates as they came together with (especially) the French and the English. It was obvious that they did not know how they were going to be received and they were studying the situation—feeling out the atmosphere. It was as though their antennae were stretched out feeling for invisible waves. They were treated, however, with the most perfect courtesy, and the tone of the whole conference was cordial and unruffled. The conference itself was a significant one in the history of plant protection, although it had no especial bearing upon the point we are trying to show in this chapter, which is the growth and esteem among the workers in pure science for the workers in applied entomology.

By 1925 the Third International Congress of Entomology was arranged and was held at Zurich. There men from many countries, interested in all phases of entomology, met in number and carried on a meeting which lasted for six days. There had surely been a change since the Oxford meeting. Very many economic entomologists were present. The meetings of the Section of Economic Entomology were largely attended. Two of the principal speakers at general sessions of the whole Congress were economic entomologists, and the writer had the honor of presiding over the first of these general sessions after the opening session which of course was conducted by the President of the Congress, Prof. A. v. Schulthess of Switzerland.

Again, two years later, the Tenth International Congress of Zoology was held at Budapest—the first since 1912 at Monaco. Obvious international differences were absent from this meeting. Germans, French, English, Poles, Belgians, Austrians, Hungarians, Czechs, Jugoslavs, Italians, Rumanians, and Americans met in a spirit of perfect fraternity. Two of the best attended and most attractive general talks were given by economic entomologists, and the Section of Economic Zoology was not only popular but all of the papers presented before this section referred to entomology.

To return to our own country: After the election of S. H. Scudder to the National Academy of Sciences in 1877, no entomologist gained this honor in more than 30 years, and when finally another one was elected he was not a worker in applied entomology although connected with the Bussey Institution of Harvard which was established as an agricultural research institution. I refer to Dr. W. M. Wheeler. The first strictly economic entomologist to be elected was the writer, in 1916¹ and I have a suspicion that, if it had been thoroughly understood by the members of the Academy that he was so pronouncedly utilitarian in his work and his views, he might have failed. It is quite possible that his efforts in the organization of science, as long evidenced by his permanent-secretaryship of the American Association for the Advancement of Science had more influence in bringing about the election than anything he had done in the field of agricultural or medical entomology. Two years later Prof. S. A. Forbes was elected to the Academy, and here again I fear that possibly he was elected in spite of his work in economic entomology rather than because of it. Two years later again, the writer was made President of the American Association for the Advancement of Science, the second entomologist to whom this honor had come in the 70-odd years of the history of the organization. However, in spite of doubts as to real reasons, it may be concluded safely that there has been a great change and that an economic entomologist can hold up his head among the workers in so-called pure science.

As a matter of fact, the results achieved by the workers in pure science in many fields are sure to be utilized sooner or later in the warfare against injurious insects.

The final paragraph of an eloquent address made by E. Roubaud of the Pasteur Institute in concluding his term as President of the Entomological Society of France (1927) contains the following (translated):

In concluding, I have another wish to express, namely that of seeing our Society show its activity more and more to the outside world, to impress the world especially by the services it renders. It no longer suffices that we should work in the serene peace of our laboratories; we must open a window on the side of life. The rôle of insects in human existence appears greater day by day. In an epoch like ours, essentially practical and utilitarian, we can no longer neglect this point of view. Will it not be possible to establish here a sort of information office about useful or injurious insects and the ways of destroying

¹The first economic entomologist to be made an honorary member of the Entomological Society of France was the writer (1905) and he was also the first man of this class to be made honorary fellow of the Entomological Society of London (1916).

them—by means of public lectures or conferences to arouse the interest of the public with regard to the work of the Society? It seems to me that this will be worth while and that we will wish to discuss it at our leisure. * * *

With a vivid realization of the probable extent of insect damage at the present time and with a nightmarish conception of possibilities in the future, I have, especially during the past 10 years, used every good opportunity to stress the facts as I see them, either in writing or in rather infrequent talks before audiences of different kinds.

These audiences have often been either not interested in insects at all or they have seen in them curious creatures to be classed with the birds and wild flowers as convenient objects in nature study. To such people the old-fashioned idea of the entomologist as rather a trifle is still apt to hold, but, since every one must be educated, I have always made the effort to combat the old idea even with people who will apparently be of little use in the serious warfare that already exists and is constantly growing more serious.

Since women exert much influence in the life of the world, I have not considered it inappropriate to point out that entomologists are not always to be ignored, even socially. I have pointed out, for example, that very many high-placed people have interested themselves in the collection of insects. One of the late grand dukes of Russia, King Boris of Bulgaria, the late Lord Walsingham of England, the present Lord Rothschild, the late Baron Osten-Sacken of Russia and Germany, and very many others are included among the persons who not only have taken great delight in amassing collections of insects, but have given certain groups serious study and have contributed greatly to the true science of entomology. Baron Osten-Sacken and Lord Walsingham were perhaps the most conspicuous examples of the latter group.

Aside from European nobility, many wealthy persons have been entomologists; and the great work done by such amateurs of means as the Oberthürs of France and Dr. William Barnes and Mr. B. Preston Clark of the United States is abundantly recognized.

It seems strange with all this that none of these titled or wealthy persons have interested themselves especially in applied entomology. I fail to remember any one of either of those classes who has contributed toward the public welfare by studying insects from the economic point of view, except possibly Miss Eleanor A. Ormerod of England who, although not a person of very great wealth, carried on investigations for years at her own expense and published very many pamphlets, also at her own expense, for free distribution to the farming classes. In the United States, where the greatest advances

have been made and where the economic situation has been longest appreciated, I know of no wealthy person who has taken up the serious study. Harris and Fitch were poor men; Walsh made a modest competence before he was able to devote his few remaining years to ardent study and vigorous writing. All the others have been poor men, although, fortunately, to a mere handful has come in later life, from some source or another, money enough to carry on in good shape and to leave something to their families.

COMPARATIVE AMOUNT OF PUBLICATION BY DIFFERENT COUNTRIES

Here once more the invaluable "Review of Applied Entomology" comes to our aid. I have made no attempt to estimate the number of publications on the subject of medical entomology. It has been very great, and practically every country in the world has contributed. In agricultural entomology, a few facts as to publication may be of interest. In a broad way we may assume that the country which has published the most has taken the liveliest interest in the subject and probably has the greater number of workers.

In 1916 the Review of Applied Entomology published a tabulation of the abstracts published in the first three volumes of the Review. The numbers ran as follows: 1913, 1,037; 1914, 1,494; 1915, 1,773. In each year the number of publications issued in the United States was considerably larger than in any other country, and in 1915 comprised about one-third of the whole number, with Russia second, Great Britain third, Canada fourth, France fifth, Australasia sixth, and Italy seventh. The detailed list is readily available and is published on page 1 of Volume 4 of the Review.

During the period from the close of 1915 to September, 1929, there were reviewed 23,430 papers. I have been interested in analyzing this list with the assistance of my friend and colleague, Mr. W. F. Tastet, and the main results will not be uninteresting. It will perhaps hardly be worth while to include the names of countries of which less than 100 papers have been reviewed, but with the others the list runs as follows:

United States.....	7,311	(of these, 2,115 were published by the Federal Government, 4,383 by officials of the State Experiment Stations, and 813 by others).
Germany	2,029	
France	1,894	
Russia	1,886	
England	1,429	

Canada	1,135
India	1,011
Australia	904
Italy	699
Dutch East Indies.....	513
Japan	392
Brazil	384
South Africa	353
Hawaii	315
Argentina	219
Spain	199
Switzerland	177
Egypt	152
Sweden	140
Philippines	136
New Zealand	135
Porto Rico	128
Czechoslovakia	121
Austria	112

Among those of less than a hundred, Belgium, Chile, Cuba, Fiji, Mexico, Poland, Rhodesia, Scotland, Guiana, Denmark, and British East Africa are recorded with more than 50 each.

I imagine that this statement gives as fair an idea of the relative activities of the different countries as could easily be shown. Of course, the real value of the different publications varies very greatly. Some are long and most important; others are short and relatively unimportant. But each one is useful. Possibly the Imperial Bureau of Entomology, in publishing its very competent Review, has done the greatest single service to applied entomology that can be thought of by the present writer.

CONCLUSION: THE OUTLOOK

The harm done by insects to the human race appears to have been increasing with growing rapidity for very many years. The realization of this fact has come to us only in comparatively recent times. And still more recently have we come to realize that we ourselves have created the conditions that have brought this about. But it seems that we have at last awakened to the danger and that good minds in rapidly increasing number are looking at most of our insect problems in an understanding way. The insect problem as a whole, however, has an almost infinite number of aspects, and to bring the insects under control as we have done with most other forms of life will need the cooperative work of very many fine minds of all the advanced nations in the years that are coming. It will not be the insects that will

bring about mass starvation of the human race, for, if we do not invent new food, we will at least learn how to grow our old plant foods in such a way as not to encourage insect multiplication. And the time will surely come when we will have conquered the insect menace, when we will have discovered means of holding them in check—so much so that notable loss from their work will have ceased except where ignorance or carelessness prevails.

A facetious friend, to whom I was saying something like this the other day, said "Yes, I expect to live to see legislation creating insect reserves, or preserves." This satirical remark did not dampen my enthusiasm, since I have great faith in human intelligence in spite of our many stupid, blundering ways. In fact, I countered by telling my friend of the talk by N. C. Rothschild before the Second International Congress of Entomology at Oxford in 1912. Mr. Rothschild explained the steps that had been taken in Great Britain to create reserves where the indigenous fauna and flora might flourish unmolested, and dwelt upon the vanishing insects in famous collecting spots. He was followed in the discussion by his brother Walter (now Lord Rothschild), by the Rev. F. D. Morice of England, by E. Olivier of France, C. Kerremans of Belgium, Y. Sjöstedt of Sweden, F. Wichgraf, P. Speiser, and H. J. Kolbe of Germany, and the writer—all speaking of nature-preserve movements in their own countries or of instances where civilization had ruined favorite collecting places.

As a matter of fact, although we are prone to dwell at length upon the enormous opportunities that civilization has given insects, it has nevertheless reduced their opportunities in many instances. For example, the settling of the northwestern part of the United States and the bringing of very large areas under cultivation have resulted in the practical disappearance of the so-called Rocky Mountain locust, or "Colorado grasshopper" (*Melanoplus spretus*). Again, the so-called seventeen-year locust, or periodical Cicada (*Cicada septendecim*) is lessening in number. Larvae hatching from eggs deposited in a given year and entering the soil, when ready to emerge as adults 17 years later, have sometimes found that an entire city has grown up during their long preparatory stages, and are unable to reproduce. But these instances are all too few, and on the whole, as we have so often said, civilization has been upsetting the balance decidedly in favor of the increase of injurious insects.

In spite of my optimism as to the ultimate results, I do not underestimate the difficulties. In fact, during the past 10 years or more I have dwelt as forcibly as possible and upon all possible occasions on

the very great danger that confronts humanity. Yes, we have the great advantage of intelligence, but we must use that intelligence in this direction. I have urged my colleagues who can speak and write forcefully, and my journalist friends who know just how to present things to the public, to push the movement. I do not think we have done too much of this; I think we should keep it up. The same facetious friend tells me, "You are as bad as a roadside advertisement; you make me tired." But I am used to him; he would make me tired too if he had not said it with a twinkle in his eye which showed that really he quite agrees with me.

The intelligence of the human race, *if brought to bear*, will conquer the insect menace.



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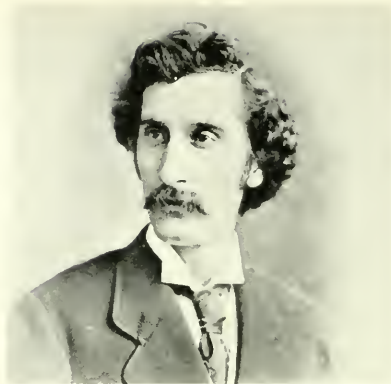


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1. Townsend Glover (1813-1883)
2. Asa Fitch (1800-1878)
3. William Dandridge Peck (1763-1822)
4. Thomas Say (1787-1834)
5. Thaddeus William Harris (1795-1856)



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1. Benjamin Dann Walsh (1808-1866)
2. Charles Valentine Riley (1843-1895)
3. Alpheus Spring Packard (1839-1905)
4. Cyrus Thomas (1825-1910)
5. William LeBaron (1814-1876)



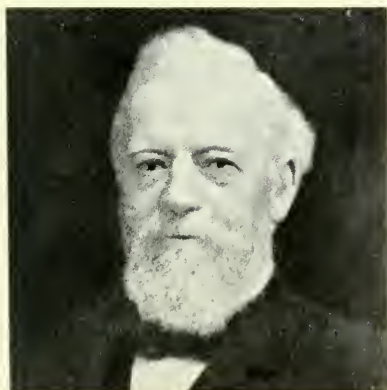
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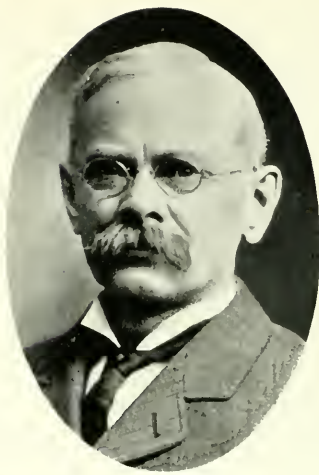


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1. Samuel Stehmann Haldeman (1812-1886)
2. Francis Gregory Sanborn (1838-1884)
3. Simon Snyder Rathvon (1812-1891)
4. Thomas Meehan (1826-1901)
5. Samuel Hubbard Scudder (1837-1911)



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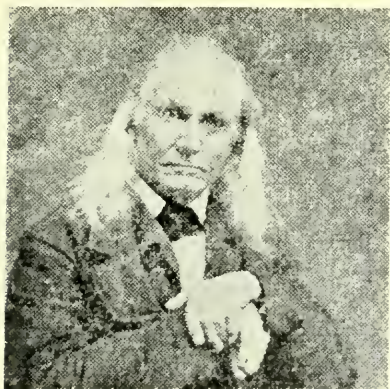


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1. Hermann August Hagen (1817-1893)
2. John Henry Comstock (1849-)
3. Henry Shimer (1828-1895)
4. Albert John Cook (1842-1916)
5. Joseph Albert Lintner (1822-1898)



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1. Edmond Ruffin (1794-1865)
2. Andrew Samuel Fuller (1828-1866)
3. Mrs. Mary Lua Adelia (Davis) Allen Treat (1835—)
4. Miss Mary Esther Murtfeldt (1848-1913)
5. John Lawrence LeConte (1825-1883)



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1. George Hazen French (1841—)
2. Daniel William Coquillett (1856-1911)
3. Joseph Duncan Putnam (1855-1881)
4. Miss Emily Adella Smith (Mrs. Pigeon)
5. Augustus Radcliffe Grote (1841-1903)



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1. Charles Henry Fernald (1838-1921)
2. Lawrence Bruner (1856—)
3. Stephen Alfred Forbes (1844-1930)
4. Herbert Osborn (1856—)
5. Francis Huntington Snow (1840-1908)



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1. Francis Marion Webster (1840-1916)
2. Mark Vernon Slingerland (1864-1909)
3. John Bernard Smith (1858-1912)
4. Wilton Everett Britton (1868—)
5. Henry Torsey Fernald (1866—)



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1. Henry Guernsey Hubbard (1850-1899)
2. Otto Lugger (1844-1901)
3. Ephraim Porter Felt (1868—)
4. Harrison Garman (1858—)
5. Clarence Preston Gillette (1850—)



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1. Theodor Pergande (1840-1916)
2. Albert Koebele (1852-1924)
3. Charles Lester Marlatt (1863—)
4. Frank Hurlbut Chittenden (1858-1928)
5. Eugen Amandus Schwarz (1844-1928)



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1. Andrew Delmar Hopkins (1857)
2. Altus Lacey Quaintance (1870—)
3. Walter David Hunter (1875-1925)
4. Everett Franklin Phillips (1878—)
5. Albert Franklin Burgess (1873—)



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1. Charles James Stewart Bethune (1838—)
2. James Fletcher (1852-1908)
3. Arthur Gibson (1875—)
4. Charles Gordon Hewitt (1885-1920)
5. William Saunders (1835-1914)



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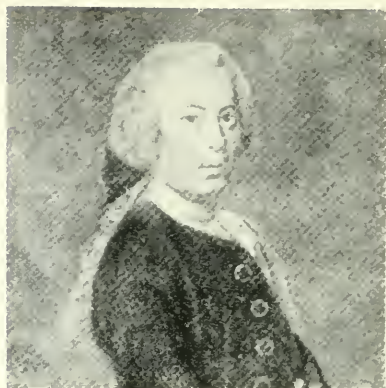


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1. Sam Macias Valdez.
2. Julio Riquelme Iñda
3. Alfonso L. Herrera (1868—)
4. Alfredo Dugès (1827-1910)
5. Alfons Ernst Alexius Michael Dampf (1884—)



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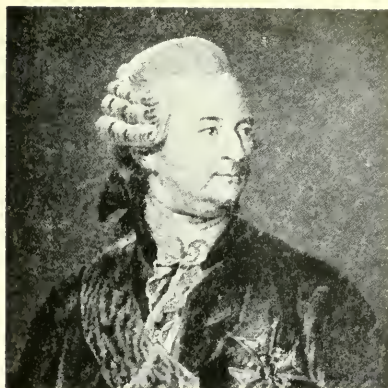


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1. Maria Sibylla Merian, "Frau J. A. Graff" (1647-1717)
2. August Johann Roesel von Rosenhof (1705-1759)
3. Francesco Redi (1626-1698)
4. Johannes Goedart (1620-1668)
5. Antonio Vallisnieri (1661-1730)



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1. Johann Wilhelm Meigen (1764-1845)
2. Charles DeGeer (1720-1778)
3. René Antoine Ferchault de Réaumur (1683-1757)
4. Pierre André Latreille (1762-1833)
5. Johann Christian Fabricius (1745-1808)



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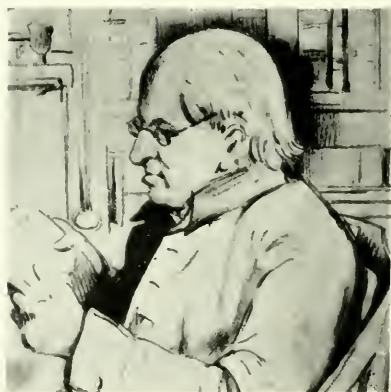
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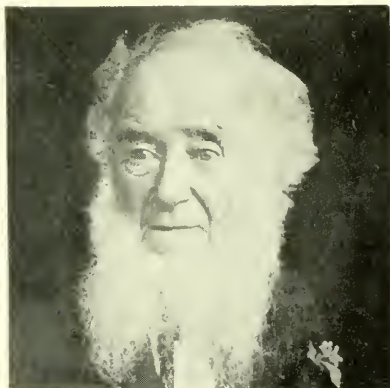
1. Johann Leonard Frisch (1666-1743)
2. Pieter Lyonnet (1707-1789)
3. Jan Swammerdam (1637-1680?)
4. Pierre Francois Marie Auguste Dejean (1780-1845)
5. William Kirby (1759-1850)



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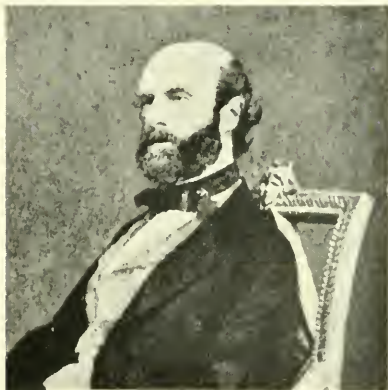
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1. Eleanor Amie Ormerod (1828-1901)
2. Frederick Vincent Theobald (1868-1930)
3. John Obadiah Westwood (1805-1893)
4. John Curtis (1791-1862)
5. Alexander Henry Haliday (1806-1870)



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1. John Claude Fortescue Fryer (1886—)
2. Frederick Muir
3. Sir Guy Anstruther Knox Marshall (1871—)
4. Cecil Warburton
5. Augustus Daniel Imms (1880—)



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1. Valéry Mayet (1839-1909)
2. Julius Emile Planchon (1823-1888)
3. Paul Marchal (1862—)
4. Jean Baptiste Alphonse Boissudal (1799-1879)
5. Paul Vayssière (1889—)



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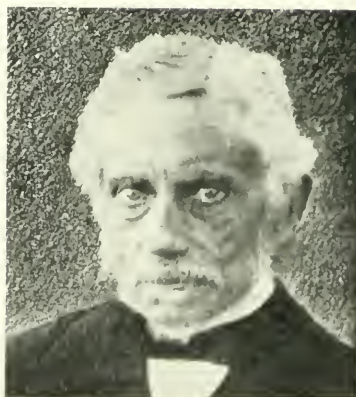
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1. Antonio Villa (—1885)
2. Achille Costa (1823-1898)
3. Camillo Rondani (1807-1879)
4. Adolfo Targioni-Tozzetti (1823-1902)
5. Achille Costa (1823-1898)



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1. Giovanni Passerini (1816-1893)
2. Antonio Berlese (1863-1927)
3. Filippo Silvestri (1873—)
4. Gustavo Leonardi (1866-1918)
5. Giacomo del Guercio (1863—)



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1. Vincent Kollar (1797-1860)
2. Ludwig Reh (1867—)
3. Karl Escherich (1871—)
4. Julius Theodor Christian Ratzeburg (1807-1871)
5. Ernst Ludwig Taschenberg (1818-1898)



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1. Karl Sajó
2. Geza Horvath (1847—)
3. Josef Jablonowski (1863—)
4. Jan Ritzema-Bos (1850-1928)
5. August Langhoffer (1861—)



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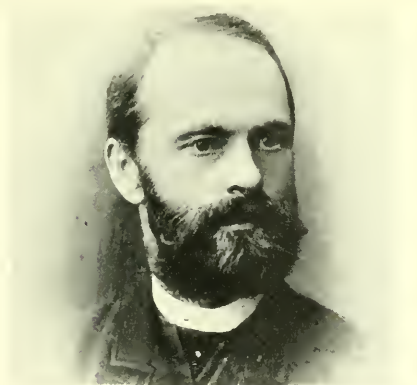


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1. Frederick Wilhelm August Meinert (1833-1912)
2. Sven Lampa (1839-1914)
3. Sofie Rostrup (Jacobsen) (1857—)
4. Matthias Thomsen (1860—)
5. Jorgen Matthias Christian Schiödt (1815-1884)



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1. Wilhelm Moritza Schöyen (1844-1918)
2. Ivar Trägårdh (1878—)
3. Karl Lindemann (1844-1929)
4. Nicholas Alexandr Cholodkovsky (1858-1921)
5. Josef Aloizievich Porchinski (1848-1916)



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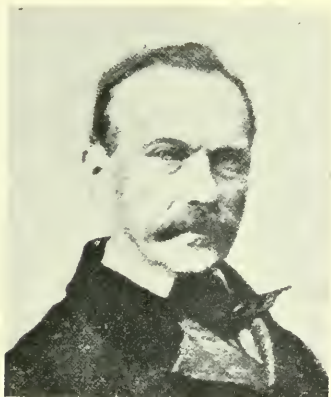


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1. Michael Rimsky-Korsakov (1873)
2. Wladimir Petr Pospelov (1872)
3. N. V. Kurdiumov (1882-1917)
4. Ivan Nik. Filipjev (1880—)
5. Nicolai Nicolaevitsch Bogdanov-Katjkov



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1. Frantisek Antonin Nickerl
2. Ottakar Nickerl
3. Heinrich Uzel (1868—)
4. Franz Klapalek (1863-1919)
5. J. Borcea
6. Wilhelm K. Knechtel (1889—)



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1. Ryszard Bledowsky (1886—)
2. Julius Komarek (1892—)
3. Zygmunt Atanazy Mokrzecki (1865—)
4. Stepan Soudek (1889—)
5. Frantisek Rambousek (1886—)



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1. Enzo Rafael Reuter (1867—)
2. Maximilian Rudolph Standfuss (1854-1917)
3. Henri Faës (1878—)
4. Anton v. Schulthess-Rechberg (1855—)
5. Uno Saalas (1882—)
6. Otto Schneider-Orelli (1880—)



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1. Ignacio Bolívar de Urratia (1850—)
2. Candido Bolívar y Peltain (1897—)
3. Leandro Navarro y Perez
4. Demetrio Delgado de Torres
5. Manuel Aulló y Costilla



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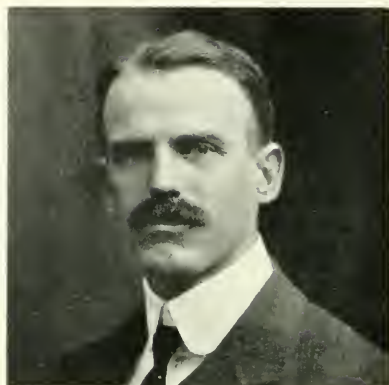


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1. Anthero Frederico de Seabra (1876)
2. Shinkai Inokichi Kuwana (1871—)
3. Shonen Matsumura (1872—)
4. Yasushi Nawa (1857—)
5. Chujiro Sasaki (1857—)



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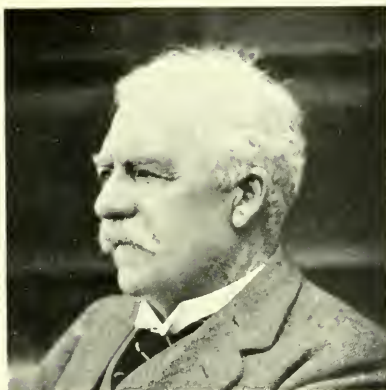
1. Harold Maxwell Lefroy (1877-1925)
2. Charles Pugsley Lounsbury (1872—)
3. Charu Chandra Ghosh (1884—)
4. Claude Fuller (1872-1928)
5. Thomas Bainbrigge Fletcher



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1. Jacobus Christian Faure (1891—)
2. Peter MacOwen (1830-1909)
3. Louis Péringuey (—1924)
4. Archibald H. Ritchie
5. Thomas James Anderson



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1. Lewis H. Gough
2. Gilbert Storey (1891-1922)
3. Fred Shaw
4. Edward Ballard (1888—)
5. E. W. Adair
6. Carrington Bonsor Williams (1889—)



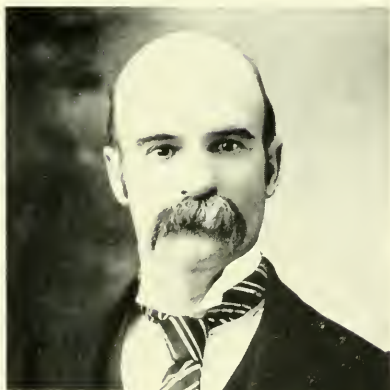
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1. Mohammed Kamal Bey (1893—)
2. Hassan C. Efflatoun Bey (1893—)
3. Naguib Eff. Iscander (1891-1928)
4. Walter Wilson Froggatt (1858—)
5. Charles French (1843—)



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1. Robin John Tillyard (1881—)
2. Edward H. Thompson
3. Robert Veitch
4. Henry Tryon
5. Harry Hargreaves (1893—)



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1. Thomas Broun (1838-1919)
2. William Miles Maskell (1840-1898)
3. Frederick Wollaston Hutton (1836-1903)
4. David Miller (1890—)
5. H. C. Pratt



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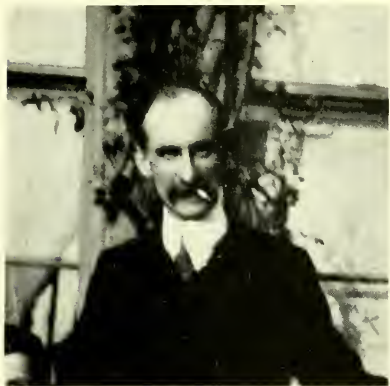


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1. Louis Philibert le Cosquino de Bussy (1879—)
2. Karal Willem Dammerman (1885—)
3. Pieter Van der Goot
4. Walter Karl Johann Roepke (1882—)
5. Jacob Christiaan Koningsberger (1867—)



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1. Robert C. L. Perkins (1866—)
2. Otto Herman Swezey (1869—)
3. Edward Macfarlane Ehrhorn (1862—)
4. Walter M. Giffard
5. David Timmins Fullaway (1880—)



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1. Henry Arthur Ballou (1872—)
2. Frederick William Ulrich (1870—)
3. George Norton Wolcott (1889—)
4. G. E. Bodkin
5. Delos Lewis Van Dine (1878—)



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1. Juan Brethes (1871-1928)
2. Hermann Conrad Burmeister (1807-1892)
3. Carlos Moreira (1869—)
4. Manuel Jesus Rivera
5. Frederico Guillermo Carlos Berg (1843-1902)



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1. Edwin C. Reed (1841-1911)
2. Gregorio Bondar (1881—)
3. J. V. V. Boas
4. Francisco Campos R. (1878—)
5. Carlos Emilio Porter (1870—)



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1. Frederic Webster Goding (1858—)
2. Charles Henry Tyler Townsend (1863—)
3. Patricio G. Cardin
4. Stephen Cole Bruner (1891—)
5. Roberto Sundberg



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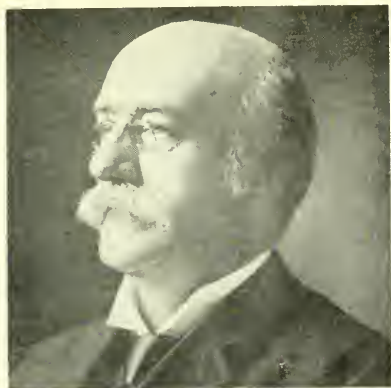


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1. Sir Patrick Manson (1844-1922)
2. Sir Ronald Ross (1857—)
3. Sir Andrew Balfour (1873—)
4. Sir Arthur Everett Shipley (1861-1927)
5. Prof. George Henry Falkiner Nuttall (1862—)



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1. Dr. Albert Freeman Africanus King (1841-1914)
2. Dr. Walter Reed (1851-1902)
3. Dr. James Carroll (1854-1907)
4. Dr. Aristides Agramonte (1868—)
5. Dr. Jesse William Lazear (1866-1900)



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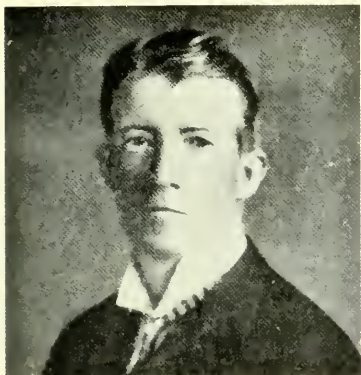


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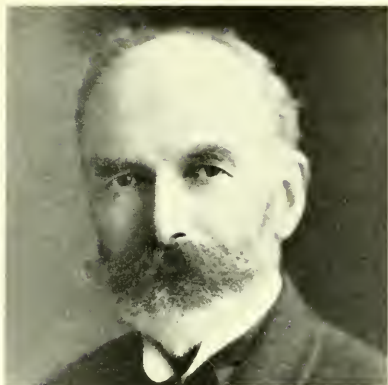


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1. Dr. Joseph Hill White (1859—)
2. Dr. Henry Rose Carter (1852-1925)
3. Dr. Theobald Smith (1859—)
4. General William Crawford Gorgas (1854-1920)
5. Dr. Howard Taylor Ricketts (1871-1910)



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1. Sir Rubert William Boyce (1864-1911)
2. Prof Robert Newstead (1859—)
3. Dr. John William Watson Stephens (1865—)
4. Lieut. Col. Alfred William Alcock (1859—)
5. Dr. Malcolm Evan MacGregor (1880—)



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1. Dr. Emile Brumpt (1877—)
2. Dr. Alphonse Laveran (1845-1922)
3. Dr. Edmond Sergent (1876—)
4. Prof. Raphael Anatole Emile Blanchard (1857-1919)
5. Dr. Etienne Roubaud



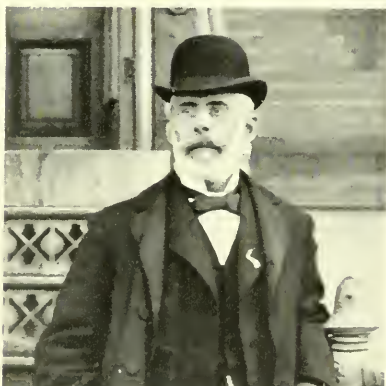
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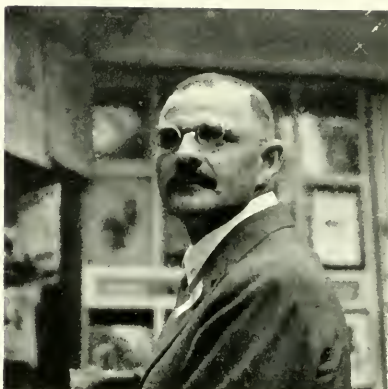


4

1. Prof. Giovanni Battista Grassi (1854-1925)
2. Dr. Angelo Celli (1857-1914)
3. Dr. Carlos John Finlay (1833-1915)
4. Dr. Juan Güterras (1852-1925)



1



2



3



4

1. Dr. Erich Christian Wilhelm Martini (1880—)
2. Dr. Albrecht Hase (1882—)
3. Dr. Charles Nicolle
4. Dr. C. Bonne and Mrs. C. Bonne-Wepster



1



2



3



4



5

1. Dr. Oswaldo Gonçalves Cruz (1872-1917)
2. Adolfo Lutz (1855—)
3. Dr. Arturo Neiva (1880—)
4. Dr. Emil August Goeldi (1859-1917)
5. Dr. Angelo da Costa Lima (1887—)

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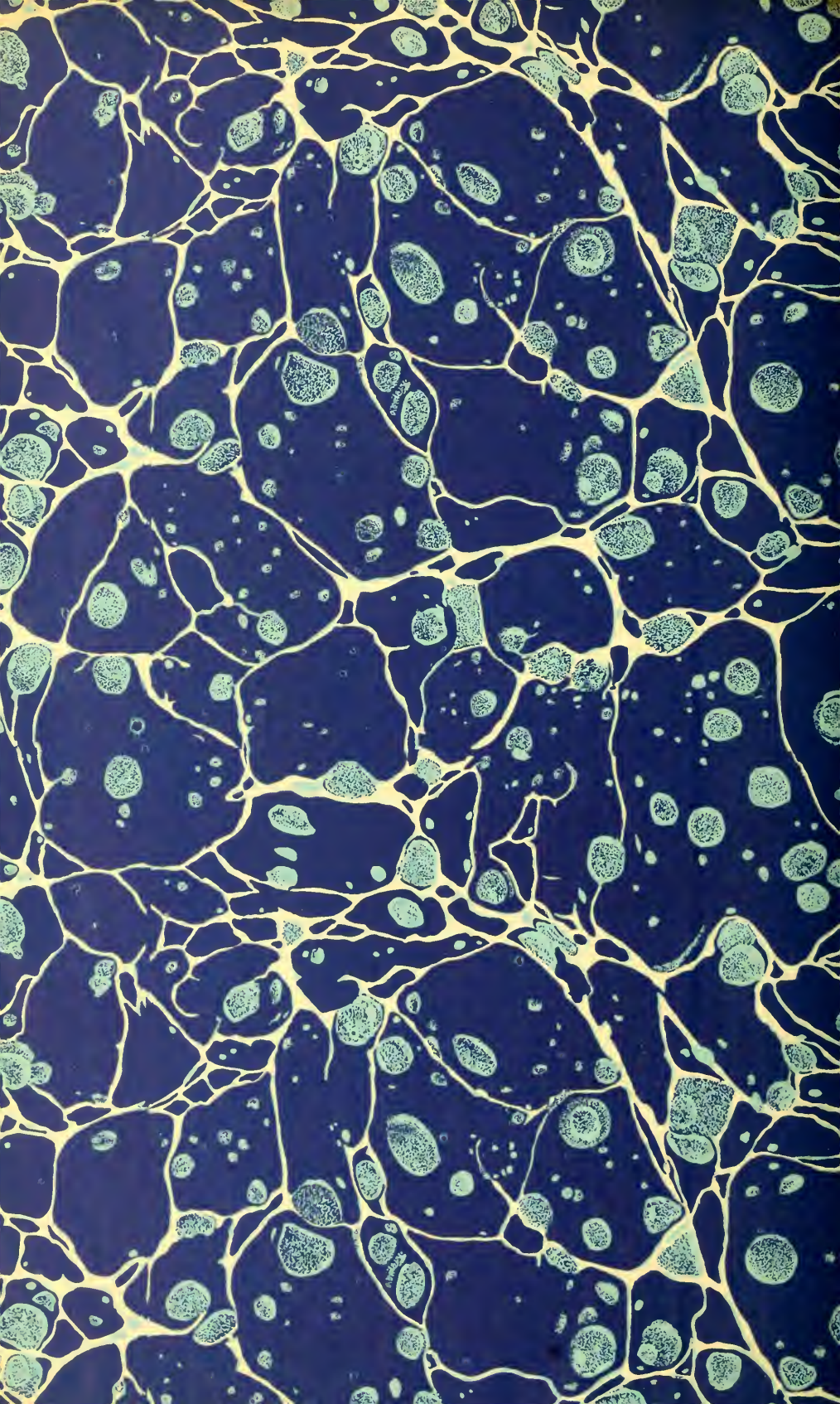
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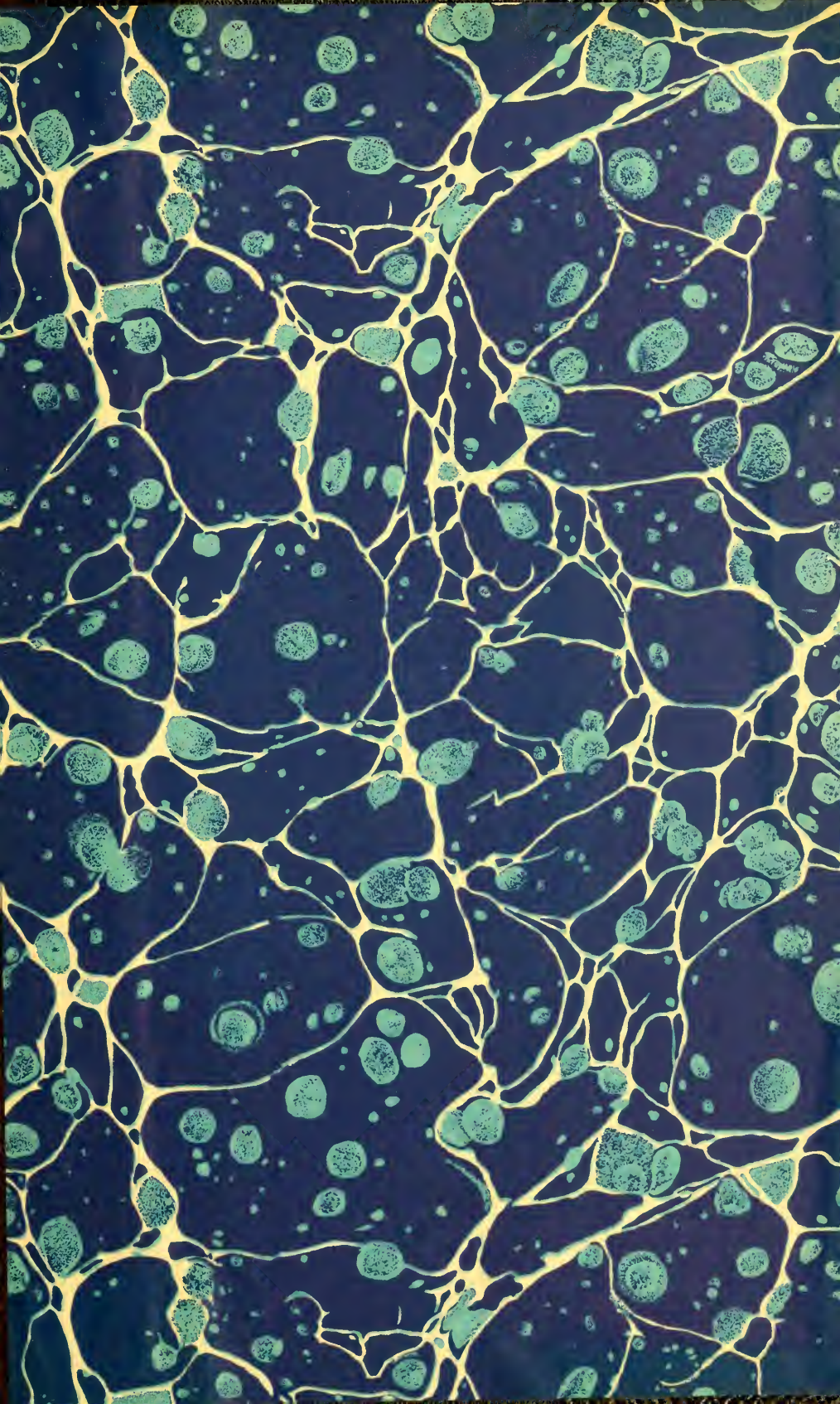
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